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HONORING LORD KELVIN.

On June 15 and 16 next, the University of Glasgow and the City of Glasgow will fittingly celebrate the fiftieth anniversary of Lord Kelvin's tenure of the Chair of Natural Philosophy in the University of Glasgow, and a committee representing these two bodies has extended an invitation to other bodies that have enrolled Lord Kelvin's name among their members to send a representative to the proposed celebration. The science of electricity does not include a more honored name than that of Lord Kelvin, and some of the most representative electrical organizations in this country have expressed their acknowledgment and appreciation of his valuable services to the science by adding his name to their roll of membership. This naturally implies their right to participation in any movement having for its object the conferring of honors upon one so worthy, and the committee having the arrangements in charge have very gracefully acknowledged that right by inviting those bodies to send a representative to the celebration. Fifty years' continuous service in so eminent and important a position as that occupied by Lord Kelvin is indeed a rare event, and this fact, taken in connection with his distinction in the scientific world, renders the occasion a particularly appropriate one for extraordinary felicitation. Lord Kelvin became Professor of Natu al Philosophy in 1846. He was 26 years of age when he assumed this important chair, having been born in 1820. His years entitle him to reverential honor, and his achievements to the admiration of mankind.

KINDERGARTEN METHODS OF INVESTIGATION.

The reference which we made in the editorial columns of our last issue to the "kindergarten" methods of experimenting on the part of our professors has not been well received, our remarks having apparently been to some extent intensified by one or two letters which appeared in another column. We must admit that in passing judgment upon the work here, and in comparing it to the work abroad, it should be remembered that abroad they had several weeks the advantage of us in having a full account of Prof. Röntgen's discovery. Also that the study of vacuum tube phenomena has not been with us such a favorite subject of investigation, and as there were at first very few good tubes to be had, some excuse exists for the manner in which our professors at first carried on their investigations. The opportunity offered to many to emerge from the oppressive depths of obscurity proved irresistible, and as a consequence men who lacked the very essence of scientific spirit immediately burst forth with all the possible *éclat*, resulting in a veritable flood of promiscuous articles from every conceivable source. The demand on the part of the hospitals for perfecting the methods so as to be applicable to their use, the popular desire for lectures, and the more or less freedom with which some of the laboratories have been used by visiting surgeons and patients, to a certain extent, accounts for the temporary reversion to the "kindergarten" stage. We know the woes of the college professor, and we are sorry if we have done him an injustice. The character of the investigations have, we are glad to say, rapidly improved, and we trust that results will be shortly announced which will add credit to the professors and material advances to science.

THE METRIC SYSTEM.

There has been presented before the present session of Congress no measure, perhaps, having a more important bearing upon our commercial relations and manufacturing industries than that re-

cently reported by the Committee on Coinage, Weights and Measures to the House of Representatives, in which the adoption of the metric system as the only legal system of weights and measures in the United States is unanimously advocated. About 75 years have elapsed since this step was first strongly recommended, and 30 years since the metric system was recognized by Congress as legal throughout the Union. During this entire period the desirability of adopting this system has at different intervals been urged upon Congress, but the result seems to show that such matters are not taken up with the same alacrity as, for instance, certain questions pertaining to foreign policy. Although the measure will meet with considerable opposition by those more or less directly affected, yet in the end its results must be of incalculable benefit, and to no branch of industry is this more true than to that of electricity. The fact that the design of all electrical machinery is fundamentally dependent upon the metric system, making it necessary, therefore, under present conditions, to transform all results to English measure, in order to conform with workshop practice, partially shows the absurdity of present methods. This bill may not be in every respect all that could be desired, yet it is a measure in the right direction. As it now stands, it provides "that from and after the first day of July, 1898, all the departments of the Government of the United States, in transaction of all business requiring the use of weight and measurement, except in completing the survey of the public lands, shall employ and use only the weights and measures of the metric system. That from and after the first day of January, 1901, the metric system of weights and measures shall be the only legal system of weights and measures recognized in the United States." The first clause, which takes effect July 1, 1898, will result in the adoption of the metric system by all concerns competing for government contracts and in this way gradually introduce the system, so that by January 1, 1901, all branches of industry will have become accustomed to its use. As it is but a question of time before the old system will be overthrown and the metric system adopted, the sooner steps are taken to bring about this result the more easily can it be effected. Once the system is adopted by the United States, England will of necessity follow, thereby resulting in a uniform system of weights and measures throughout civilized countries. We have always advocated the adoption of the metric system and will continue to constantly uphold such action, believing, as we do, that it is a measure which will be heartily welcomed by the electrical profession.

"CATHODIC," NOT "ANODIC."

The fact that further and more careful investigation forces Prof. Elihu Thomson to retract a statement made by him in a previous communication to The Electrical World, which was in effect that the anode and not the cathode is the probable source of Röntgen radiance—a statement in which he was apparently supported by Prof. Rowland—simply illustrates how easily false conclusions may be drawn even from very carefully performed experiments. Opinions advanced by such eminent investigators are generally accepted as, to a certain extent, authoritative, although not, as in the present instance, without further corroboration, and it is therefore to be regretted that, in many other cases as well as the present, more decisive demonstrations were not attempted before advancing unconditional statements. Prof. Thomson corroborates by more recent experiments an opinion more or less accepted by others, that the fluorescence of the material forming a part of the tube is not a necessary condition for the production of Röntgen rays. When, however, the tube is entirely of glass, as is generally the case, the presence and character of the fluorescence offers, doubtless, an indication as to when the best effects are to be obtained, and it is perhaps to this extent only that fluorescence plays any important rôle. Although it is still a question as to whether the action produced by Röntgen rays on a sensitive photographic plate is due to the fluorescence of the emulsion, it has been conclusively shown that by the presence of fluorescence in the vicinity of the dry plate its action is materially accelerated, and it is by this meansthat the time of exposure has been greatly reduced. This fact, which was first called to our attention by Dr. Pupin, seems to have been recently withheld from public notice by several other investigators, and in at least one case, apparently with no other object than a desire to claim the shortest time of exposure on record. Considerable amusement must be afforded to those who, in their moments of relaxation, stop to reflect upon the humor of such antics.

SECTIONAL COILS FOR FIELD MAGNETS.

Modern induction coils are wound in a number of sections, which effectively prevent too close proximity of those portions of the winding between which there is a high difference of potential. The frequency with which the insulation of 500-volt shunt field coils is punctured by abruptly breaking the field circuit suggests that the same method of isolated sections be applied to field windings. Every field-winder knows that a long layer is more difficult to wind and insulate than a short one, and in view of this fact the added expense of the method suggested would probably be slight. In addition to the great advantage of providing a field spool that could not possibly be broken down by electromagnetic discharge, the sectional construction would greatly promote ease of repair. It frequently happens that an entire field spool must be removed to find and repair a single defect. With the sectional construction the fault could be located in its particular section and thus avoid the necessity of unwinding the whole magnet. Aside from the labor saved, both wire and insulation are much deteriorated by unwinding and rewinding, but with the construction indicated this deterioration would apply to the faulty section only. Last, but by no means least, if the magnet winding were designed to be highly efficient and used but little current, the breaking down of one of its sections would not disable it. By simply short-circuiting the defective section, or, in case of a ground, removing it from the field circuit altogether, the magnet winding would generate exactly the same magnetizing flux as before, with the exception that it would run a little hotter and use a little more current. This may save a shut-down in a lighting station, a contingency that almost every lighting superintendent strives to avoid, even at the sacrifice of his machinery. The sectional method presents so many apparent advantages that it seems worthy of more complete exploitation than it has hitherto received.

Vortex Theory of Röntgen Rays.

In the March number of the *American Journal of Science* is to be found a discussion by A. A. Michelson on a new hypothesis to account for the phenomena produced by Röntgen rays and the action of vacuum tubes. Experimental results, he thinks, are opposed to the two theories hitherto advanced, viz., that of longitudinal waves and that of projected particles, and he gives as his hypothesis an "Ether-Vortex" theory. He supposes the Röntgen rays to be vortices of an intermolecular medium (provisionally, the ether). These vortices are produced at the surface of the cathode, which forces them out from among the molecules of the cathode.

By considering the phenomena presented from this standpoint he thinks that difficulties hitherto presented are explicable. It would seem that since a high vacuum is essential within the tube, while outside the rays pass through all sorts of objects, it is regarded that the hypothesis he puts forth offers a solution if it be considered; that in order that ether vortices may result from an electrical impulse, this impulse must be communicated to them, and that it must not be dissipated in the interchange of molecular charges which either accompany or produce the discharge at both high and moderate pressures. The absence of ordinary light phenomena of reflection, etc., he considers would follow from the nature of the vortices.

The Convention of the National Electric Light Association.

A partial list of papers and topics to be presented at the Nineteenth Convention of the National Electric Light Association, which will be held in New York City on May 5, 6 and 7 next, is given below :

Papers.—"Single-Phase Self-Starting Synchronous Motors," by F. H. Leonard; "Results Accomplished in Distribution of Light and Power by Alternating Currents," by W. S. R. Emmet; "Acetylene Gas," by Mr. Ferguson, of the Chicago Edison Company; "Evolution of the Arc Lamp," by L. H. Rogers; "Steam Boilers: Their Equipment and Management," by Albert A. Cary; "Electrolysis," by Capt. William Brophy; "Evolution of Interior Conduits, From an Electrical Standpoint," by Luther Steiringer; Lecture.—"The Light of the Future," by D. McFarlan Moore. Topic.—"The Desirability of a Standard Socket," discussion to be opened by Alfred Swan.

The sessions will be held in one of the large rooms in the Industrial Building, Lexington Avenue and Forty-third Street. The hotel headquarters will be the Murray Hill Hotel, Park Avenue and Forty-first Street, within two blocks of the convention hall. The hotel rates to delegates have been fixed at $2.00 per day and upward on the European plan; $4 and upward on the American plan.

Annual Report of the American Bell Telephone Company.

The annual meeting of the American Bell Telephone Company was held in Boston on March 31. The annual report for the year ending Dec. 31 last, shows the following results, compared with those shown in the report for the year previous :

Gross earnings	$5,124,952	$4,848,244
Expenses	1,911,193	1,724,459
Net earnings	$3,213,759	$3,123,785
Regular dividends	$2,502,453	$2,400,000
Extra dividends	630,000	600,000
Total surplus	$2,151,011	$2,151,011
Earnings and expenses in detail:		
Earnings:		
Rentals	$2,125,359	$2,502,992
Dividends	2,523,149	*1,937,657
Extra territorial	148,694	100,939
Telegraph	32,422	29,352
Real estate	76,175	69,675
Interest	215,320	190,455
Miscellaneous	3,831	5,172
Totals	$5,124,952	$4,848,244
Expenses:		
Operation	$495,611	$430,340
Legal expenses	182,754	178,342
Real estate	37,452	35,798
Interest and taxes	245,536	356,478
Commission	296,284	459,958
Royalty	1,452	5,000
Concessions	649,508	231,713
Miscellaneous	2,592	26,827
Totals	$1,911,193	$1,724,459
Ledger balances Dec. 31.		
Debtors:	1895.	1894.
Telephones	$1,285,946	$1,209,787
Real estate	1,045,926	950,926
Stocks	44,121,680	38,268,455
Merchandise and machinery	14,054	14,232
Bills and accounts receivable	3,463,213	4,355,554
Cash and deposits	1,337,892	760,776
Total	$51,268,715	$45,559,733
Creditors:		
Capital stock	$21,500,000	$20,000,000
Premium account	1,398,435	.....
Debentures	2,000,000	2,000,000
Bills and accounts payable	§1,120,616	‡1,107,949
Patent account profit and loss	12,713,309	10,228,571
Profit and loss	6,349,444	5,849,444
Reserve	4,035,399	4,222,756
Surplus	2,151,011	2,151,011
Total	$51,268,715	$45,559,733

* No portion of the earnings of the Metropolitan Telephone & Telegraph Company were divided.

‡ Of this amount $900,000 is for the dividends payable Jan. 15, 1895, to stock of record Dec. 31, 1894.

§ Of this amount $967,500 is for the dividends payable Jan. 15, 1896, to stock of record Dec. 31, 1895.

Further comparative statistics show :

	1895	1894
Telephones Dec. 20	674,976	582,506
Exchanges Jan. 1	927	867
Branch offices	686	572
Miles wire on poles	260,324	232,008
Miles wire on buildings	12,861	14,525
Miles wire underground	184,515	148,285
Miles wire, marine	2,028	1,856
Total miles of wire	459,728	396,674
Number of circuits	237,837	212,074
Number of employees	11,930	11,094
Number of stations	281,695	243,432
Number daily connections	2,351,420	2,088,152

In his report President Hudson says that not only has the business increased with such great strides during the year, but the tendency to turn itself into the best class of service, metallic circuit, has continued without abatement, or rather has increased in rapidity. Jan. 1, 1896, finds the total number of metallic stations 94,747 ; being a gain during the year of 40,067 over the number with which the year began.

In the Long Distance Company's system there were on Jan. 1, 1896, in operation 5804 miles of pole line and cables and 90,251 miles of wire connecting 149 offices, an increase during the year of 1187 miles of pole line and cables, 14,695 miles of wire and 14 offices. During the year the companies leasing instruments expended for new construction $6,463,000 ; for addition to real estate, $465,000 ; and for repair and construction, $7,223,000, making a total of $14,151,000 applied to extension and care of the telephone plant in the United States.

The principal cities and towns through most of the States east of the Mississippi are now connected by wire, and conversation can be held by telephone over distances of 1500 miles, which is more than twice the length of line anywhere brought into use for this purpose outside the United States.

Within the last five years alone 130,000 miles of telephone wire have been placed underground. The Long Distance Company had invested up to Dec. 31, 1895, in line construction, franchises, equipment and supplies $11,435,055.02.

The company shows an increase in gross earnings in 1895 over 1894 of 31.1 per cent., the amount for 1895, gross, being $1,326,683.89.

The stockholders re-elected the old board of directors and voted to increase the capital stock from $21,500,000 to $23,650,000.

Fire at Washburn & Moen's Works.

Fire on April 5 destroyed the spring factory of the Quinsigamond Works of the Washburn & Moen Manufacturing Company, Worcester, Mass. The loss is estimated at $175,000. This is covered by insurance. The fire originated in an oil pipe connected with one of the furnaces in the mill, which was being repaired by two men. An alarm was turned in at once, but before the department arrived the interior of the building was a mass of flame, so that the firemen were unable to get into it.

The spring factory was 100 feet in width and 275 feet long, constructed of iron and brick, with floors of wood. It was the only building in the entire Washburn & Moen plant which was considered fireproof. The company will rebuild the mill at once.

Street Railway Interests in Texas.

At the third annual meeting of the Texas Street Railway Association, which was held in Galveston on March 18 and 19 last, the subject of electrolysis of underground pipes, etc., was discussed.

Several instances were given of supposed destruction by electrolytic action, but in few of the cases could this be definitely traced, nor was there any united opinion as to plans of overcoming the trouble. It was the general opinion that heavier bond wire was necessary. Several members gave instances of trouble; in one case a six-inch condensing pipe had been perforated, but was afterward encased, with good results so far. In another case water-pipes had been badly damaged, but no main pipes. In one city the electrician had recommended that they encase the service pipes in vitrified clay sewer pipes. Some discussion was had upon the plastic bond. Only one member seemed to have much knowledge of it, Mr. Young, of Galveston. He advised its use and maintained that it was not affected by the up-and-down movement of the rails.

The question of insurance was discussed, the various remarks covering a wide range. The insurance companies were charging from 2 per cent. to 3½ per cent. on frame power-house buildings, cars on track and in sheds, and from these figures down according to the building until for detached brick car-houses the rate is 1¼ per cent.

Mr. Drake suggested the organization of the Texas Street Railway Mutual Insurance Company; that 10 per cent. of the gross earnings of each line, together with the regular insurance charges, according to board rates, be paid into the treasury annually, and that a certain percentage be kept in reserve. With the rest of the money, after $100,000 was paid into the treasury, a corporation might be regularly organized. Until that, all payments would have to be upon honor. A permanent committee upon insurance was appointed, as follows: Carl F. Drake, of Austin, chairman; H. C. Chase, of the Houston City Railway Company; J. L. Sale, of Dallas.

On the Source of the Röntgen Ray.

BY WILBUR M. STINE.

A series of experiments extending over the past six weeks has at length yielded conclusive evidence and enabled the source and distribution of the ray to be mapped out around the entire tube with great clearness. Penumbral shadows were repeatedly plotted back to the tube and invariably pointed to the area of the bulb opposite the cathode as the source of the distribution. These observations have already been published.* It occurred to the writer that the best means to trace the ray distribution would be shadows cast by short metallic tubes. Half-inch lengths were cut from No. 18 gauge brass tubing, varying in diameter from ½ inch to 3 inches. In the first experiment these were placed concentrically on a dry plate and placed parallel with the bulb in position marked 5 in Fig. 1, the distance of the plate from the bulb being four inches. The sciagraph is reproduced in Fig. 2. Two separate effects are to be noted in all the sciagraphs of the tubes used. Both the length and direction of the shadow is clearly indicated and the vertical shadow of the metal itself. It will be noted that the latter seems to indicate the presence of rays,

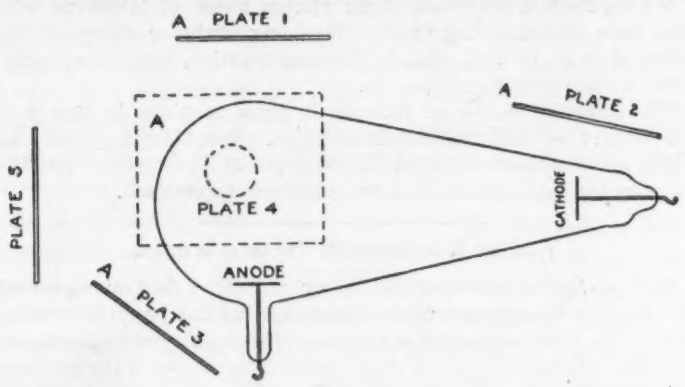


Fig. 1.

which are more or less vertical. Plotting the shadows in Fig. 2 and noting that the vertical shadow does not appear beyond the third ring, we find that the source of the rays was on the surface of the bulb, and the area of the source was nearly or quite circular, and not much in excess of the diameter of the third ring, which was

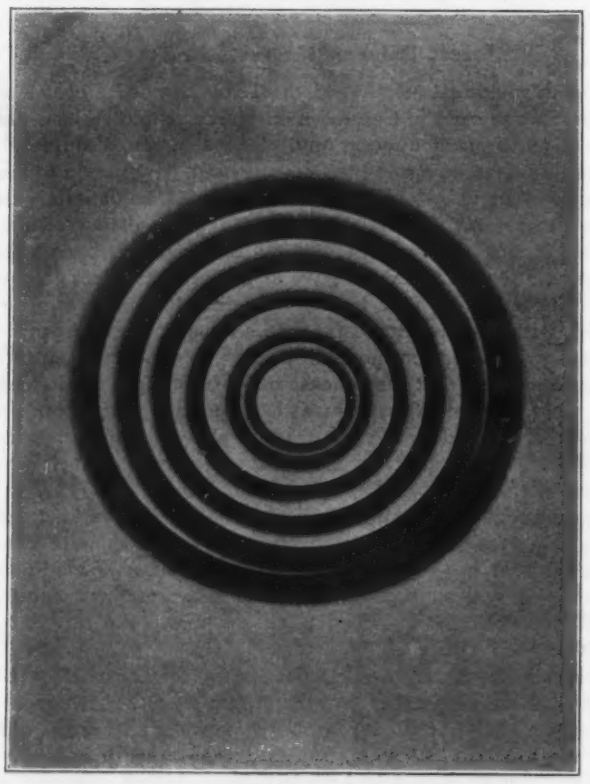


Fig. 2.

1½ inches. With such a clear and unmistakable result in possession, the next experiment was an attempt to decide whether this area was the only source of the ray. We were guided in this by some recently published emphatic statements that the ray was of anodic origin, and did not, as popularly supposed, proceed from the cathode. It was seen that while a screen could be misleading, the

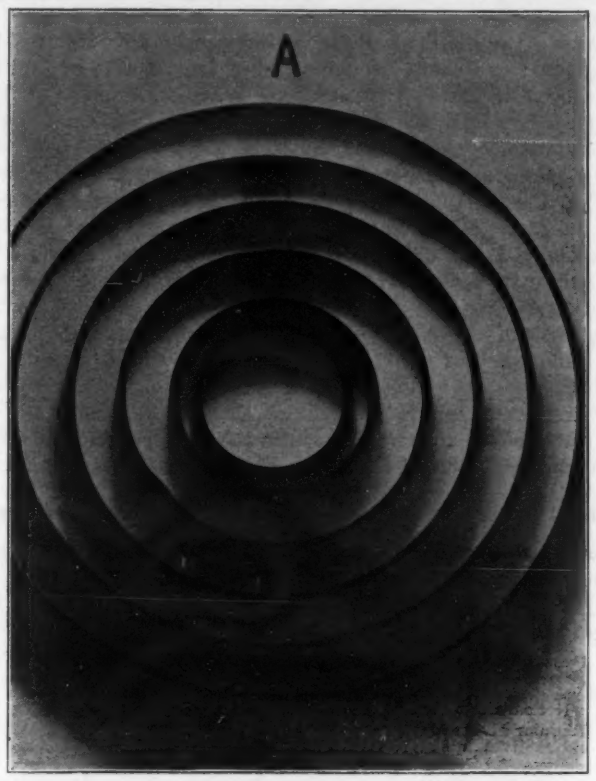


Fig. 3.

shadows cast by rings would be conclusive. Four plates were prepared for simultaneous exposure. The concentric rings were placed on one plate, and single rings of one inch diameter and same height were placed over the other plates. All these objects were placed as nearly as possible on the centre of the plates. In Fig. 1 is shown

Fig. 4.

the shape of the tube, the position of the electrodes and the plates, which were the 3¼ by 4¼ size, and placed 2½ inches from the bulb. The plates were marked with the letter "A" on the ends, which were disposed as shown in the drawing. The resulting sciagraph

*Western Electrican, March 7, p. 110; Electrical Engineer, March 11, p. 225.

from plate 1 is shown in Fig. 3; that from plate 2, in Fig. 4; from plate 3, in Fig. 5, and from plate 4, in Fig. 6.

To interpret the results, note first the sciagraphic effect of the rings, and second, the elliptical shadows of the intercepted inclined rays. If the latter be plotted, they all point to one area, the circular cathode imprint on the end of the bulb. We may now call this the prime source of the Röntgen ray. The vertical ring shadows, however, indicate numerous secondary and more or less weak sources. A general statement can then be made to the effect that about the entire surface of the tube is sciagraphically active. The four plates were developed together for an equal length of time. Plates 1 and 3 developed soonest, 4 a little slower, and the image on 2 was the last to appear. The resulting negatives are, however, all excellent and of about equal density. It is thus shown that a number of sciagraphs may be taken simultaneously if the entire tube be surrounded by plates. It might be added that the rings in Fig. 3 were held in concentric position with wedges of pine wood one-half inch thick, and since these do not show they were entirely transparent for this length of exposure.

The sciagraph shown in Fig. 3 is now, perhaps, the most interesting one of the series. It was purposely placed exactly opposite the anode. If the anode were the source of the ray the resulting sciagraph would have resembled the one shown in Fig. 2; all the shadows would have been concentric rather than elliptical. The result plainly shows that the *cathode*, not the *anode*, is the source of the X-ray. The polarity was determined by testing the charges on the poles by means of an electroscope. In Fig. 5, plate 3, the shadow points only in one direction, and since the ring was near the anode it would have shown a shadow on the opposite side had the anode been active. Fig. 4, plate 2, shows another striking result. The shadow is seen to broaden as it extends from the ring. This indicates that the rays crossed between the source and the object. The explanation is at once apparent. The rays were, in a sense, focused by the concave surface of the *interior* of the bulb, but it must not be concluded that the Röntgen ray has thus been actually focused.

If Figs. 3, 5 and 6 be carefully examined, the vertical shadows will be seen to be quite distinct, and Fig. 4 shows the same result less strongly marked. These phenomena are closely associated with the fluorescent appearance of the tube, which is decreasingly marked toward the space around the cathode.

The entire experiment here described has been carefully repeated

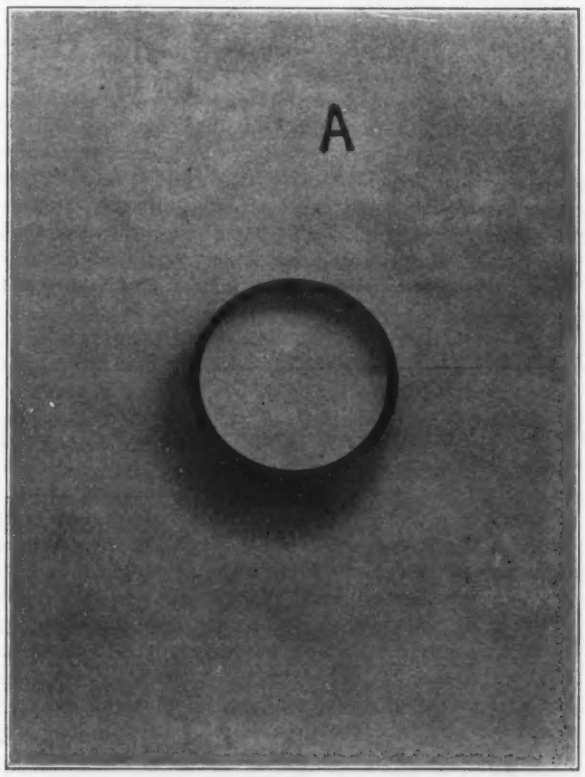


FIG. 5.

to avoid error. To summarize, it shows that there is but one marked source of the ray, that portion of the bulb opposite the cathode, and that the entire surface of the bulb is more or less a weak secondary source; that it is the cathode, and not the anode, which produces the rays. The only question which now remains is whether it is the interior or exterior of the tube that is active. There are many reasons which point to the interior surface. Another tube has just been designed to test this point. However, it would seem that the

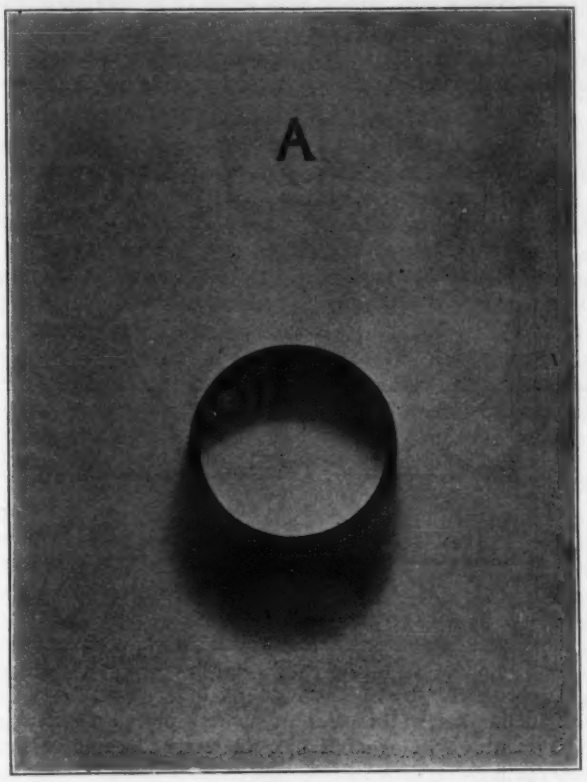


FIG. 6.

active surface would be that struck by the charged molecules. These experiments have been largely directed by the electrolytic theory of the production of the sciagraph which has been advanced by the writer.

The tube used in these tests was one especially designed to promote electrical exhaustion. The writer has advanced the opinion that this was accomplished by the occlusion of the gas by the anode. The vacuum of the tube was too low to produce the sciagraph when first tested, but after being excited for about 10 hours became quite active. If, however, the current is reversed, the tube immediately fills with the purple light at first present. This seems quite conclusive evidence and further shows that no material particles are projected through the walls of the tube.

High-Voltage Lamps.

In the discussion which followed the reading of Mr. Addenbrooke's paper before a recent meeting of the Institution of Electrical Engineers (London), Mr. Snell said that at the King's Road station, St. Pancras, the lamps were running entirely at a pressure of 220 volts. About 4000 lamps were at present installed, the greater number of which has been running about five months. They had experienced little trouble with them and he doubted if the customers really knew the difference between the present service of 220 volts and the old of 110. He has had one running for 1300 hours in his own house.

On a 440-volt supply, that is with a three-wire system with 220 volts on a side, the percentage variation would obviously be less than on a 220-volt three-wire system, and this should conduce to the longer life of the higher voltage lamps.

Mr. J. C. Robertson, in the same discussion, said the troubles which his firm had found with high-voltage lamps up to the present were practically nil, except in the case of people who had to handle the lamps in the course of manufacture. They had to use low specific resistance filaments, which were, he imagined, the only practical filaments to be used.

Mr. Geipel said that before reading Mr. Addenbrooke's papers he was under the impression that, granted the 200-volt lamp was successful, it was all up with the transformer systems; but if all that Mr. Addenbrooke said was true, then he thought those who had devoted years to the perfecting of those systems might feel that there was a vast field of use still before the results of their labors.

The Source of Röntgen Rays.

BY C. E. SCRIBNER AND F. R. MCBERTY.

In an effort to locate the source of Röntgen rays in the Crookes tube the following experiment was make: Immediately beneath the bulb was placed a screen of lead, thick enough to be nearly opaque to Röntgen rays, with a circular opening one inch in diameter immediately under the bombarded spot of the bulb; two and

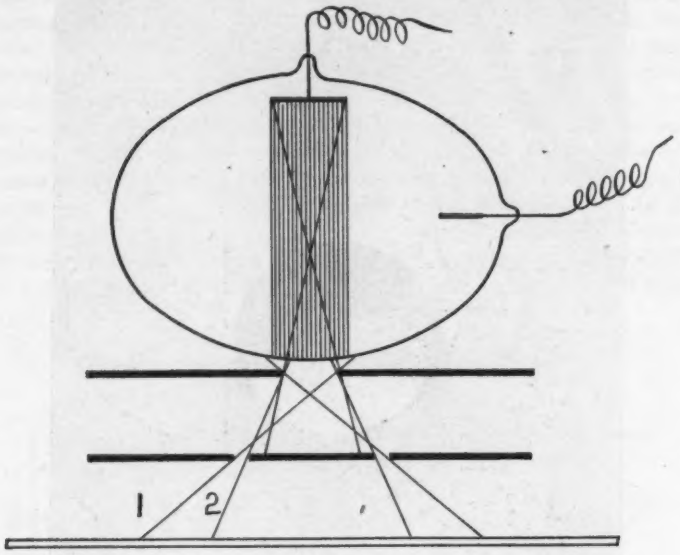


FIG. 1.

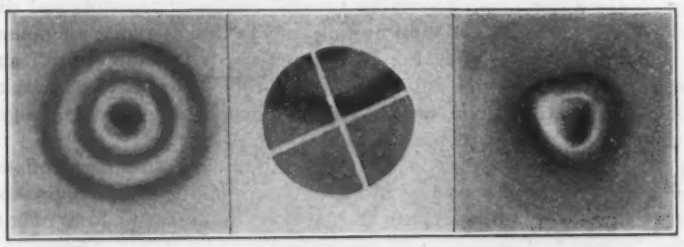
one half inches below this diaphragm was placed a second screen with two openings of one half inch diameter, located so far apart that any ray passing directly from the cathode plate through the first aperture would be intercepted by the second screen. Below the second screen was placed a photographic plate. (The arrangement is represented in Fig. 1.)

A short exposure and development of the plate brought out two densely black elliptical spots on the plate.

Referring to Fig. 1, if the Röntgen rays had proceeded from the cathode alone and in straight lines, no image would have been produced on the plate. The rays must have proceeded from some point in the tube far below the cathode to have reached the plate at all. The dimensions of the apparatus and of the spots on the plate were accurately measured, and were plotted out to scale in the way frequently used in optics. Lines 1 and 2, carried from the edges of the black spots past the edges of the screen, located the source of illumination at the wall of the bulb. Moreover, the illuminated spots on the plate showed strongly illuminated central discs surrounded by less sharply illuminated parts, such as might be expected to be produced by a source of radiation of considerable area acting through such a system of screens.

This experiment seemed to demonstrate that the rays did not proceed from the cathode alone, unless they were diffused in all directions from the wall of the tube at the point of bombardment. It, of course, did not differentiate between rays actually proceeding from the glass and rays which might proceed from matter in the same line within the bulb.

In the same experiment a pin-hole image of the bombarded spots



FIGS. 2, 3 AND 4.

of the bulb was obtained through a very small hole in the second screen.

Immediately following this experiment, acting upon the hint obtained in it, a number of pin-hole images were taken of different bulbs, the upper screen being absent. In a pin-hole photograph any source of Röntgen rays within the bulb, or on any portion of the wall of the bulb, would necessarily produce its image on the photographic plate below. In every case, however, the image on the plate was solely that of the fluorescent portions of the bombarded spot. The image corresponded in size, form and position with the utmost exactness to that which would be expected from the optical construction, on the assumption that the source of illumination was at the inner wall of the bulb. It was larger than the actual spot in the bulb, when the distance from the wall of the bulb to the screen was less than that from the screen to the photographic plate, and smaller under the reverse condition.

No image was obtained in any case of any spot or object within the bulb other than the bombarded spot opposite the plate serving as cathode. The image did not even include the diffusely fluorescent yellowish streaks radiating from the bombarded spot or flickering about the walls of the bulb. Of course, with a current which converted the two electrodes alternately into cathode and anode, two spots of bombardment would be obtained.

Figs. 2 and 3 represent two pin-hole photographs of different bulbs. The bulb used in making Fig. 2 had a plain disc of aluminum as cathode. That used for Fig. 3 had a cathode made up of a central small disc of platinum surrounded by a ring of aluminum. The bright lines in the bombarded spot and in the images do not correspond to broad surfaces of the cathode, but to edges or raised portions. These figures are made from India ink drawings copied from the negatives as faithfully as possible, on account of the unsatisfactory character of prints taken from the negatives themselves. The negatives, of course, present the shadings with greater delicacy and evenness, and the outlines more distinctly.

It will be remembered that Prof. Röntgen, in his announcement of the discovery of the new rays and their attendant phenomena, mentioned that when the stream of radiant matter is deflected by means of a magnet the rays proceed from the new spot of bombardment. This proposition of Prof. Röntgen has been abundantly confirmed by means of the pin-hole photographs. Beneath the bulb, the

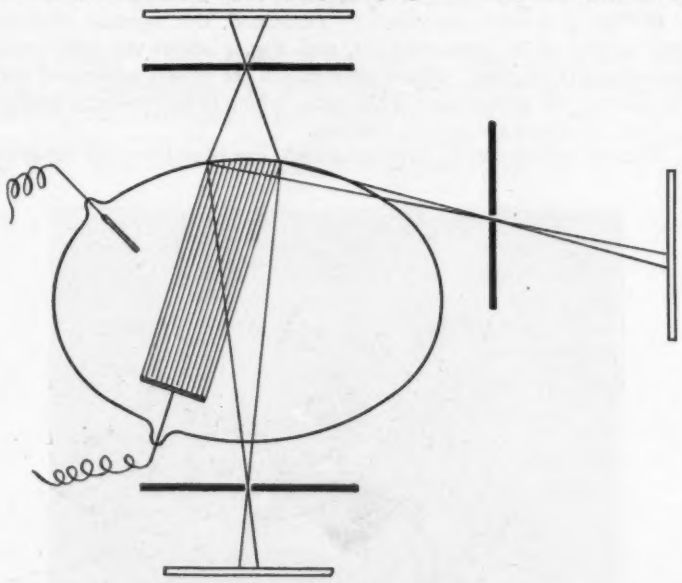


FIG. 5.

image of whose bombarded spot is represented in Fig. 3, was placed a diaphragm with a one-inch aperture having a pair of lead cross-wires extending over the aperture and crossing at its centre. The point of crossing of these wires was located immediately under the centre of the series of concentric rings which constitute the source of Röntgen ray illumination in that bulb. Beneath the diaphragm carrying the cross-wires was placed the usual diaphragm with a pin-hole aperture, and below that the photographic plate. When all was in readiness the stream of radiant matter, and consequently the spot of bombardment in the bulb, were deflected by means of a powerful electromagnet, so that the second bright ring crossed the centre of the cross-wires. After a long exposure the plate was developed; the image showed the shadow of the cross wires, and the rings which constituted the source of Röntgen rays lying eccentrically upon them, the most strongly illuminated band—that which appeared blackest on the plate—crossing the centre of the cross-wires. The source of Röntgen rays had been displaced to a different part of the bulb by the electromagnet, namely, to the new spot of bombardment. The image is shown in Fig. 4.

A similar experiment was made to determine whether the ray

itself could be deflected. The magnet was placed to act upon the pencil of Röntgen rays near the photographic plate, at such a distance that the action of the magnet did not produce any appreciable displacement of the stream of radiant matter, but would tend to produce a considerable displacement of the image upon the plate if the rays should be susceptible to its action. The plate was exposed with the magnet unexcited for 20 minutes, and then subsequently with the magnet excited for 25 minutes. If the image had been displaced by the magnet two like images in different positions should be found upon the plate. As a matter of fact, but one was found, and that in a position to indicate that the magnet was of no effect in displacing the pencil of rays outside the bulb.

The evidence of single pin-hole images of the different bulbs would seem to furnish sufficient grounds for the assertion that the Röntgen rays proceeded only from the bombarded spot at the inner wall of the tube opposite the cathode. A further experiment was made, however, which is conclusive on this point. Three pin-hole images were taken simultaneously of the same bulb. One plate and diaphragm were arranged to view the bombarded spot from immediately below. Another plate and diaphragm were placed at the side of the bulb. A third plate and diaphragm were placed above the bulb, in position to look down directly upon the bombarded spot. A special bulb was made having its cathode placed in a somewhat oblique position, so that the bombarded surface might be visible from a point in a line perpendicular to it outside the bulb, without obstruction by the cathode. The arrangement is represented in Fig. 5.

When these plates were developed after a long exposure the lower plate was found to contain the usual image of the bombarded spot at the bottom of the bulb. The plate at the side contained an inverted side elevation of the same spot. The upper plate also contained an image of the bombarded spot at the bottom of the bulb. On none of the plates was there any other image whatever, although each plate was exposed to the whole bulb. The small spot at the bottom of the bulb at the point of bombardment, on the inner wall of the glass, was the only point about the bulb from which any Röntgen rays proceeded.

The images also tended to show that the source of the ray was at the inner wall of the bulb. If it had been at the outer surface, there would have been no glass in the path of rays to the lower plate, and two thicknesses of glass in the path of those to the upper plate; hence the image on the former plate would have been much stronger than that on the latter. If the source were at the inner wall, equal thicknesses of glass would be in the paths of rays to the two plates. The images were of such depth of shading as to show that the plates had been equally illuminated, allowing for the difference in distances between the spot and the plates. No more definite experiment than this seems possible.

These pin-hole photographs were made at different times between Feb. 20 and March 15, the first described experiment having been made at the earlier date, the last described demonstration about the latter date; the experiments were reported at a meeting of the Western Branch of the American Institute of Engineers on March 25.

From all knowledge which we have been able to gain of the numerous experiments with Röntgen rays, we believe these experiments were the first to locate their source; as respects at least the large number of tubes which we have used, they located the source accurately and conclusively. So far as we can learn also no other pin-hole images of bulbs have been taken, excepting perhaps the one which Prof. Röntgen thought he had obtained. This mode of photographing promises excellent results in investigations as to the relation of the Röntgen rays to the cathode discharge.

Radiant Centres of Röntgen Rays.

D. W. HERING.

Profs. Rowland and Elihu Thomson are both on record as ascribing the Röntgen rays to action of the anode. The latter fortifies his opinion by experiments with a Wimshurst machine whose polarity is easily assured. In THE ELECTRICAL WORLD of March 14, is the account of an interesting and beautiful experiment by Prof. Macfarlane, in which he points out that the double shadows so often appearing are due to two sources of the rays. Such statements naturally excite further inquiry.

In Prof. Macfarlane's experiment the two sets of shadows of nails were plainly due to rays proceeding from the two ends of the tube, the electrodes at the ends being anodes and a plain disc midway between them the cathode. The fluorescence of the ends of the tube is due apparently to the cathode rays. The cathode evidently was not the source of the shadows, although it emitted the rays that caused the fluorescence in the remote regions of the tube from which the external effects were derived. The question is, what part did the anodes play?

The writer has made several experiments to determine more conclusively just to what extent either electrode is responsible for the effects external to the tubes, and what is the source, no matter whether it be primary or secondary, of the external radiation. A piece of sheet lead having a part lying flat upon the cover of the sensitive plate, and a part bent up to a considerable height was exposed beneath a large round Crookes tube, and the shadow compared with the relative positions of the plate, the object and the tube. The size, shape and density of the complete shadow, umbra and penumbra indicated that it was projected by rays from every part of the glass which was fluorescent. This accorded with the experience of other observers concerning the same point, but did not decide in how far the anode rays might have been the agents.

To determine this a tube in the shape of a V (one intended to show that radiant matter will not turn a corner) was placed horizontally above a sensitive plate, and a strip of sheet lead, about three eighths of an inch wide bisecting the V was placed edgewise above the plate, and at a height of nearly a quarter of an inch. The terminals of the induction coil were joined to the ends of the V, the distance between them within the tube being 16 inches. When the coil was operated the leg of the V, terminating in the cathode, fluoresced distinctly green, while the other showed only the usual pale blue illumination in the interior. The two sources of radiation were now wholly distinct from each other, but both were excited under identical conditions as to apparatus, period, etc. Upon reversing the polarity of the terminals the fluorescence changed also, the fluorescent glass being always that of the tube containing the cathode. It is not reasonable to ascribe any of this fluorescence to the anode, so long as the glass immediately within reach of anodic radiation is unaffected. If either electrode alone were the source of actinism it would cast a shadow of the lead toward the other tube in the form of a dark band; if both were active two shadows would be produced, with a band of light between them. A comparison of the shadows would show the comparative intensity of action from the two branches.

Upon developing the plate a sharp, strong shadow appeared, extending entirely across the plate, as projected by the *cathode tube*, while no effect could be traced to the anode. This does not, of course, prove that the anode produces no effect, but it does show that under moderate excitement from an induction coil the effect from the anode is at most quite insignificant. But even when a more powerful coil or a longer exposure is resorted to, may not the apparent anodic effect be explained in the following way?—

Each terminal of the secondary coil is alternately anode and cathode, and with an alternating current in the primary these terminals undergo equal changes of potential in exchanging their polarity. Hence neither would be strictly cathode nor anode. When the primary coil is supplied with an interrupted direct-current, as is well-known, the closing of the circuit induces a current (the universe) in one direction in the secondary with corresponding anode and cathode, while breaking the circuit induces a current (the direct) in the opposite direction from the former, reversing the anode and cathode. It is the cathode pertaining to this direct-induced current that is usually meant. The latter induction is so much stronger than the former as to be looked to for the effects that are produced by the coil, but effects from the former may be there nevertheless, and in a sufficient degree to manifest themselves, though not very strongly. With a feeble coil they might not become apparent photographically within such time as sufficed for the direct induction to produce a pronounced effect.

It would seem necessary to observe these inductions separately to decide whether the supposed anodic effect is not really cathodic and due to the inverse induction upon closing the primary circuit. As such it would be perceptible by a fluoroscope and by all the usual tests that are applied to determine Röntgen rays.

To Increase the Westinghouse Company's Capital.

A meeting of stockholders of the Westinghouse Electric & Manufacturing Company will be held on June 4 for the purpose of increasing the capital stock of the company from $10,000,000 to $15,000,000. The Board of Directors announce their acceptance of an offer to purchase from the company $3,000,000, par value, of the company's second preferred or assenting stock, on terms which they consider highly advantageous to the company.

Notes on General Electric Alternating-Current Machinery.—II.

THE calculation of line losses for alternating transmission systems has provoked a great deal of discussion in the past, but is still a problem which warrants considerable attention. Before continuing with the description of the apparatus of the General Electric Company, commenced in our last issue, a short treatment will follow on the practical problems involved in the calculation of lines, the running of alternators in parallel, causes and remedies for unbalancing, and the measurement of alternating-current power. These are some of the practical questions with which the engineer is confronted, and we have attempted, therefore, to present their solutions in a practical manner. We will first consider the calculation of lines.

Calculation of Lines.—In the continuous-current system the drop and the loss in the line may be readily obtained by simply multiplying the current and the square of the current, respectively, by the resistance. In the case of alternating currents the matter is not so simple, since the drop is not only due to the ohmic resistance, but also to the reactance. The resistance is practically the same whether the line be supplied with alternating or continuous-current, but the reactance, which is zero when continuous-currents are employed, has always a value in alternating-current systems. The reactance depends upon the frequency and the inductance, and is expressed by the following equation: $S = 2\pi N L$, where N is the frequency or the number of complete cycles per second, and L the coefficient of self-induction, or more properly, the inductance. This latter quantity depends upon the size of the wire and the distance between the conductors, and can be calculated for any given condition.

The influence of reactance is very prominent when using heavy copper conductors in the lines. For instance, the reactance of No. 0000 B. & S. wire is 2.5 times its resistance, but with a No. 8 wire the reactance is but one-quarter of the resistance. This illustrates the advantage to be gained by the use in multiple of as many small conductors as possible instead of a single conductor. The reactance, as stated above, may be readily calculated for any given set of conditions, or may be obtained from several tables which have been published. Knowing the resistance and reactance, the drop due to each may be obtained, by simply multiplying each by the current. The impedance drop is the square root of the square of the ohmic drop plus the square of the reactive drop or $E = \sqrt{\overline{CR}^2 + \overline{CS}^2}$ when s is the reactance.

The loss in the line depends upon the resistance, and is expressed by C^2R. The reactance being in quadrature with the current, does not represent a loss in power.

To make a complete and exact calculation of the conditions of current and E. M. Fs. in a long line is a complicated problem, but in general, very good approximate results may be obtained by several methods. The following is an example of the application of one of these methods.

We will calculate a line suitable for supplying a 1000-kw three-phase power transmission with a distance of 10 miles, and at a difference of potential of 10,000 volts, employing 60 cycles per second. We will assume that the power factor of the load, which may consist of induction or synchronous motors and lights, is 90 per cent., or, in other words, the energy consumed is 90 per cent. of the total volt amperes transmitted. We will further assume that the step-up and step-down transformers each have a hysteresis loss of 1½ per cent., that the copper loss in each is ½ of 1 per cent., that the magnetizing current is 4 per cent., and that the reactance drop is 4 per cent. Further, that the total loss in the power transmitted is to be 10 per cent.

Since the total hysteresis and copper losses in the two transformers is 4 per cent., the loss in the line will be 6 per cent. The difference of potential between any two conductors will be $\frac{10{,}000}{\sqrt{3}} = 5775$ volts. Consequently the energy current for each phase, that is, in each conductor, will be 58 amperes, since each phase is to supply 333 kilowatts. As 6 per cent. of the total volts is about 350 volts the CR drop will be 350 volts. With a power factor of 90 per cent., the total current in each conductor will be $\frac{58}{.9} = 64$ amperes. It follows that since $CR = 350$ volts; $R = \frac{350}{64} = 54$ ohms, or, since the line is to be 10 miles long, .54 ohms per mile. The resistance per mile of a No. 0 B. & S. wire is .518 ohms, and this, therefore, will be about the proper size to suit our conditions. The reactance of No. 0 wire, at 60 cycles per second, is seven-tenths of an ohm per mile, or seven ohms in this particular case. The CS drop, that is, the drop due to reactance, is $7 \times 64 = 448$ volts, or about 8 per cent. of the total voltage between two conductors. The energy voltage consumed in the two conductors is twice one-half of 1 per cent., or 1 per cent. As the energy volts consumed in the line is 6 per cent., the total drop in the energy voltage will be 7 per cent. The voltage consumed by the reactance in the step-up and step-down transformers will be twice four or 8 per cent., and the reactive voltage consumed in the line, as calculated, is 8 per cent., and consequently the total reactance drop will be 16 per cent.

The energy current loss in each transformer, due to hysteresis, will be 1½ per cent., or for the two, 3 per cent. The wattless or magnetizing current in the two transformers is 8 per cent. The percentage of the wattless current in the load, since the power factor is 90 per cent., will be $\sqrt{1 - .90^2} = 44$ per cent. Consequently at the generator, the energy current is $90 + 3 = 93$ per cent., and the wattless current is $44 + 8 = 52$ per cent., and consequently the total current is $\sqrt{\overline{93}^2 + \overline{52}^2} = 106.5$ per cent. of the current at the secondary terminals of the step-down transformer.

Therefore the current at the generator is 6 per cent. larger than the current at the receiving end.

The energy voltage at the generator will be 90 per cent., which represents the power of the load, plus 1 per cent., which represents the ohmic drop in the two transformers plus 6 per cent., which represents the ohmic drop in the line, giving a total of $90 + 6 + 1 = 97$ volts. The idle volts are 44 per cent. corresponding to the idle voltage of the load, 8 per cent. due to the reactive drop in the line, and 8 per cent. due to the reactive drop in the transformers, giving a total of 60 per cent. Therefore the voltage at the generator is $\sqrt{\overline{97}^2 + \overline{60}^2} = 114$ per cent. of the voltage of the secondary terminals of the step-down transformers.

The voltage at the generator has therefore to be 14 per cent. larger than the voltage at the receiving end, consequently the total volt amperes per phase at the generator will be 114 times 106.5 or 121 per cent., giving a power factor of 82 per cent.

If the charging current of the line is to be taken into consideration, it being 90° ahead of the impressed E. M. F., it has to be subtracted from the wattless current due to reactance, which is 90° behind the E. M. F. In this particular case the charging current is .17 amperes per mile or 1.7 amperes in this line which is 10 miles long, or in other words it is equal to 3 per cent. of the total current. The total actual idle current flowing in these lines is therefore not 52 per cent., but $52 - 3 = 49$ per cent. The total current will be $\sqrt{\overline{93}^2 + \overline{49}^2} = 105$ per cent. instead of 106.5 per cent. as before found.

In connection with this it may prove of interest to investigate the possibility of resonance in a line similar to the one just calculated.

Complete resonance occurs when the self-induction of the line is entirely neutralized by the capacity or when the charging current is large enough to set up an E. M. F. of self-induction which is of the same magnitude as the impressed E. M. F. producing the charging current.

When this condition is present, then if the resistance of the line were zero, the current would flow indefinitely without an impressed E. M. F., or if an impressed E. M. F. be supplied to the line, the latter will be raised to an infinitely high potential. Of course this can never actually take place, since the possible rise of voltage in the line is limited by its resistance, but in any system there is always a certain degree of resonance present.

We will now investigate to what degree the voltage will rise in this particular line due to incomplete resonance. We found that the charging current was 3 per cent. of the whole current. The total reactive drop between the generator and the line is 12 per cent., being 4 per cent. reactive drop in the transformer, and 8 per cent. in the line. Consequently the counter E. M. F. of self-induction at full load will be 12 per cent. of the total, and therefore the counter E. M. F. of self-induction due to the charging current will be 3 per cent. of this 12 per cent.; that is, .36 per cent., and consequently the maximum possible rise in potential will be only .36 per cent.

This is upon the assumption that the impressed E. M. F. and the current are simple sine waves. If the wave shape is distorted; that is, consists of a fundamental wave with superimposed higher harmonics, the possibility of resonance is greatly increased. Since both the charging current and the E. M. F. of self-induction are propor

tional to the frequency, the effect of resonance, which is directly proportional to the capacity and the self-induction, increases as the square of the frequency. It follows, therefore, that if the wave of impressed E. M. F. is not quite sinusoidal, but has a noticeable triple harmonic, the rise in potential due to resonance is more marked.

If the triple harmonic were of the same magnitude as the fundamental wave, then the rise in potential which it would produce due to incomplete resonance would be 3×3 times as large as the fundamental; that is, nine times .36 per cent., or 3.2 per cent., but as the triple harmonic never attains the magnitude of the fundamental a rise as large as this cannot occur. Assuming that the triple harmonic has amplitude of 30 per cent. of the fundamental sine wave, we get the rise due to the triple harmonic of 30 per cent. of 3.2 per cent., or about 1 per cent. In the line under consideration, supplied with a current from a three-phase alternator, the triple harmonic is 30 per cent. of the fundamental wave; therefore, the rise in voltage due to resonance will amount to only 1 per cent. This clearly shows that in machines having a distributed winding and a very nearly perfect sine wave of impressed E. M. F., the effect of resonance need only be taken into consideration in long lines employing very high potentials. If we make our calculations in the same manner for 1000 kilowatts, but for a distance of 100 miles and 30,000 volts, we find that the resonant rise would be great if the impressed E. M. F. is not a true sine wave.

It is stated by the experts employed by the General Electric Company that transformers supplied with sine wave and non-sine wave E. M. Fs. give widely differing core losses. From actual tests it has been found that the difference in loss may amount to as much as 10 per cent. This depends upon the character of the flat topped wave of magnetization. Since the maximum value of the flat wave is less than the maximum value of the sine wave of magnetization corresponding to a sine wave-shaped E. M. F. and since the core loss depends upon the maximum magnetization, the core loss is less with a flat wave of magnetism, that is, a pointed or saw-tooth wave of E. M. F., than with a sine wave.

Parallel Running of Alternators.—The fact that it is the common practice both in this country and in Europe to run alternators in parallel, leaves no doubt as to its feasibility, but naturally some types of machines are better adapted to this purpose than others.

The smooth-core machines are in some respects not as good as the ironclad, owing to the fact that a slight variation in the field excitation of one of the machines causes a very large cross-current to flow between the two, thus loading them up with idle current. Further, if the machines are not completely in synchronism when thrown together, an exceedingly large cross-current will flow when closing the switch.

A machine having a very high self-induction is not suitable, as it will not allow sufficient synchronizing current to flow between the machines. Consequently the best synchronous motors or generators for parallel running, considered from a commercial standpoint, should have a moderate self-induction, that is, be of the ironclad type, and have a comparatively small armature reaction.

The moment at which two single-phase alternators are in synchronism may be readily determined by connecting the secondaries of two transformers in series, with one or more lamps, the primaries being each connected to one machine. Synchronism will occur when the lamps no longer glow.

In synchronizing three-phasers care must be taken to have all three

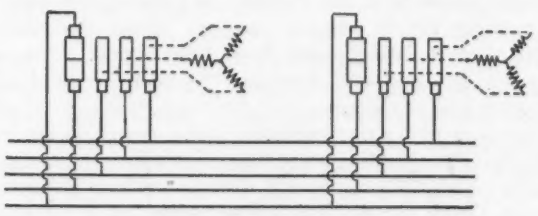


FIG. 25.

phases in synchronism. The safest and simplest method of determining this, is to place in series between each corresponding pair of legs, a series lamp bank and see when all three banks are dull. When this is the case the machines may be thrown in multiple.

When the potential is high it is advisable to step down by means of transformers. If the machines are self-compounding it is not sufficient to have only the mains of the machines connected in multiple, but also to have the series windings connected in multiple.

This can be done as shown in Fig. 25. If the commutator is put in to but one leg, great care must be taken in order to synchronize correctly, so that not only the three phases are synchronized, but also those two particular phases, which have the commutators, may be thrown together.

Unbalancing of Alternators.—A drawback in the polyphase distribution is the possibility of unbalancing the different circuits. Although this disadvantage is very much less marked than supposed, it does occur, but with reasonable care in the installation it will be hardly noticeable.

It is impracticable to give any definite figures about the magnitude of this unbalancing, as it depends upon the type of machines used, the condition of the line, etc. To be sure that no unbalancing will occur, it may prove desirable to follow the rule of distributing the load with the same care as in the Edison three-wire system.

In the monocyclic system no unbalancing is possible, since all the load is on the same circuit, and this circuit is the only circuit on the machine.

Unbalancing, however, whatever be the system, does not have a very serious influence on the potentials.

Measuring of Alternating-Current Power.—In the single-phase system the power supplied by a generator can readily be measured by means of a wattmeter, having the current coil in one line and the potential coil between the lines. The total watts supplied by the generator are then directly read.

The apparent output is the product of the current and the potential; the power factor of a single phase system is then found by dividing the wattmeter readings by the product of volts and amperes.

The power may be determined about as readily in the three-phase system as in the single phase.

The first method that suggests itself is to employ three wattmeters, each having the current coil in one of the lines, and a potential coil connected between the three single phases. This method gives the full power, but since all alternators do not have the *Y* connection (which is necessary to give common connection) this method cannot always be used. Furthermore, it introduces the use of three wattmeters, which makes it rather complicated and expensive.

If the load is balanced in the three branches the three wattmeters should read the same power, and consequently it would be necessary to use but one, and multiply the reading by 3.

Another method of measuring the three-phase power is to use two wattmeters having their current coils connected in two of the lines,

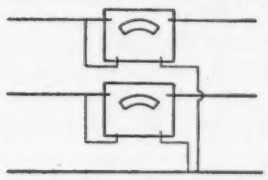


FIG. 26.

and the potential coils between these respective lines and the third line as shown in Fig. 26. If the power factor of the machine is more than 50 per cent. the wattmeters will read positive. If the power factor is less than 50 per cent. one of the meters will give negative readings. To get positive readings one of the leads will have to be reversed. The total watts will, in the first case, be the sum of the two readings, and in the second case the difference. Instead of using two independent wattmeters, one wattmeter would suffice if this is provided with two armatures and two fields.

The third method of measuring the power is the use of an artificial neutral point. Three wattmeters have to be used, if the load is unbalanced and one wattmeter if the load is balanced. To get the artificial neutral points; that is, an artificial common connection, it is necessary to have three resistances connected together, each going from one of the lines, and of such magnitude that the total resistance of the three circuits (one including the resistance of the wattmeter) is equal.

The total volt-amperes, that is the apparent power from the three-phaser is the product of the volts between the lines times the current in the lines times the $\sqrt{3}$; that is, 1.73 $\times$ volts $\times$ amperes. Consequently the power factor is $= \frac{\text{total watts}}{1.73 \times \text{volts} \times \text{amp.}}$

In the quarter-phase system the power can be measured with a wattmeter in each of the individual circuits as shown in the case of the single-phase system. If the circuits are equally loaded the total power will be twice the power in one phase; that is, twice the power that is read on one wattmeter, having a current coil in one of the lines, and a potential coil across the lines of the same phase. If the power is not equally distributed, two wattmeters will have to be used. The total power is the sum of the two readings. The total volt-amperes, if the load is balanced, are twice the volts between the

two mains of one phase times the current in that phase, or if the load is unbalanced the sum of the volts times amperes in each phase. The power factor is as before, $\frac{\text{total watts}}{\text{total volt} \times \text{amp.}}$

Electric Lighting in a Pioneer Town.

BY J. W. DICKERSON.

Cripple Creek is a well-lighted city, and in this fact may be found one of the principal reasons for the orderliness which prevails in the camp. Residents remark with a great deal of pride that as the streets are well illuminated and as the city marshal is unusually vigilant, a stranger is much safer at night than in any large city. The camp was lighted by electricity long before its name became familiar in the East and before it enjoyed its present remarkable prosperity. Electricity indeed, in the early days and now, formed the only practicable means of illuminating the town, for gas was wholly out of the question owing to the exorbitant rates charged by the railways for transporting coal in the mountain districts.

The Fremont Electric Light & Power Company installed its electric light plant in April, 1892, in a frame structure built on stilts, in the style characteristic of early buildings in mining camps. The distinguishing part of the company's name was applied, because it was supposed that the site chosen for the station was in Fremont County; the correction in the original surveys indicated that the location was in El Paso County, but the name of the corporation has not been changed to correspond. The first station contained two Thomson-Houston arc machines of a combined capacity of 85 lamps, and two 750 Thomson-Houston alternators.

The present station, which is located on South Third Street, not far from the Florence & Cripple Creek Railroad depot, was constructed last of all. It is built of brick which were made in Cripple Creek, and it is one of the most pretentious structures, both in respect to appearance and construction, to be seen in the city. It seems to be a remarkably substantial structure when compared with the ordinary buildings in Cripple Creek, as in the latter the wind is likely to blow the clocks from the walls at any time, as recently happened in the local telephone exchange. The dimensions of the station are 58 by 100 feet, and it is one story in height. The dynamo and engine room and the office occupy the front of the building; the boiler room is at the rear of the station, and a small apartment is provided as an oil room.

The electrical machinery has a capacity of 170 arc lights and 2250 incandescent lamps. The generators are as follows: Two 50-light and two 35-light arc dynamos and three 750-light alternating-current machines. All the dynamos are of the Thomson-Houston type; they are belted to two Ball engines, one of 150 horse-power and one of 85 horse-power, and to one Armington & Sims engine of 150 horse-power. The dynamo room is high and well ventilated, and light is furnished by windows on three sides.

The boilers are four in number, one of 85 horse-power, one of 100 horse-power, one of 125 horse-power and one of 150 horse-power, and were furnished by the Pennsylvania Boiler Works of Erie, Pa.

Both wood and coal are used as fuel, but preference is given to the former for reasons of economy. Several cords of wood are kept piled up in the boiler room ready for immediate use. Steam coal, which is brought from Canon City, costs $5.85 in Cripple Creek, and of this amount $3.50 represents the sum paid per ton for freight. This is an extraordinary charge for transporting coal a distance of 49 miles, but perhaps it is not altogether unreasonable, as freight must be lifted a mile in the air in that distance.

On account of the unusual cost of fuel high prices for electric light prevail in the camp, but that they are not regarded as extortionate or prohibitive is indicated by the liberality with which they are employed. The electric light plant gives employment to 22 persons as follows: A chief engineer, a day engineer and fireman, who work from noon till 10 p. m., a night engineer and fireman, who work from 10 p. m. till closing down time in the morning, two trimmers, five firemen, seven men engaged on construction and three office employees.

Up to this time the company has furnished light only and the area in which the current is distributed is small; the most distant point reached by the circuits is not over six or seven blocks from the station. In the near future the company will introduce a system for distributing the exhaust steam for heating purposes. At the present time the exhaust is an entire loss, and it is not practicable to condense owing to the scarcity of water.

Plans are now under consideration for the installation of a power-plant as an addition to the station. All along up to the present time there has been a question as to the future of the camp. Doubts have been expressed whether the site would continue to be a successful gold-producing district, and it has been predicted in some quarters that after the present boom had passed away a period of decadence would commence, where investments made on the assumption of continued prosperity would become practically worthless. Prior to a few months ago Cripple Creek as a town was experiencing a decline, rents began to go down, and some places of business were closed. Although since that time prosperity has returned with a rush, conservative men hesitate about introducing, at an expense of a quarter of a million dollars, a power-plant for which there seems to be such an urgent present demand. In Cripple Creek at the present day no exception can be found to the enthusiastic prediction that the region will become the greatest gold-producing region in the world. The visitor need not proceed far without learning that there are now 220 ore shipping mines, that 1000 operating mining companies have been organized, and that the district will produce $15,000,000 of gold in 1896, as compared with $8,000,000 for 1895. If the owners of the electric light company reach this conclusion, so generally and so enthusiastically believed in Cripple Creek, a General Electric monocyclic power-plant will be installed, and the generators will be driven by two Reynolds-Corliss engines of 500 horse-power each.

It would seem as if the demand for power would be almost unlimited. It has been estimated that at the lowest calculation 150 mines within a convenient transmitting distance from the station would be ready to take power at the present time if it could be furnished them. All over the district are small mines now worked by hand-windlass or horse whim. The moment that pay ore is struck the owners will want to substitute machinery for hand-power, or animal power, in order to develop their mines more rapidly. The power for prospecting can be delivered far more satisfactorily by an electric motor than by a horse, and many of the companies which are now developing prospects would install a motor at once if current were available.

Electric Light Station at Cripple Creek.

The tendency is all in the direction of machinery. At the beginning of 1895 only 13 steam hoists were in use in mines, or for working prospects in the district, and during the year 96 were added, making 130 in service Jan. 1. Since that time several additional steam hoisting plants have been added. It is estimated that between $600,000 and $700,000 has been invested in mining machinery on the surface.

The objections to the production of steam-power on the mountain side, and the corresponding advantages attending the installation of a system by which electric power is distributed from a central station on Cripple Creek are obvious. The freight on a ton of ordinary steam coal transported from the coal field at Canon City to Cripple Creek, is, as has already been stated, $3.50 per ton. The cost of carting the fuel from the last-named city to a steam plant several miles up a steep road is in some cases even more expensive. By the time the coal reaches its destination under such circumstances its original cost is a small item compared with the expenses of transportation. At the same time, few of the mines are provided with water, and the supply for the boiler must therefore be carried up to the shaft-house in tanks at a heavy expense. While the cost of

generating power in Cripple Creek with the existing price of coal is unusually high, it is small in comparison with that of producing power on the mountain sides.

It is believed that when the new power plant is in operation power can be furnished to the consumer at a saving of from 35 to 50 per cent. of the expense which it at present costs him. When such a saving can be demonstrated there can be little doubt but that the company will find an abundance of customers.

The Gas Engine and Its Electrical Applications.*

BY CHARLES MACDONALD, M. E.

Suppose a manufacturing establishment requires 1500 horse-power, and is to be subdivided into any number of units, using the gas engine and gas generator as a means for obtaining power. This system amounts to about the same cost as the steam subdivided plant, where the gas generator corresponds to the boilers, the gas mains to the steam pipes, and the gas engines to the steam engines; but leaving the mechanical difficulties out of consideration, the gas-engine has many advantages over the steam engine. For instance, if the power in an establishment were shut down the boilers would still have to be kept going and the labor there to look after them. With a gas engine the generator could be made large enough so that in one day sufficient gas could be made to last a week; there would be no heat lost by radiation; and if one or all of the gas-engines were shut down there would be no further expense attached to them until they were wanted for use again, when they could be started in a few minutes; machinery would never slow down for want of boiler pressure, the gas generator always furnishing a regular supply.

The American Gas Engine Electric Company's plant, of Chicago, is a fine illustration of the mechanical and industrial progress of the gas engine. This plant consists of three large engines, of 60, 100 and 150 horse-power respectively. The first two mentioned have one cylinder each; the 150-hp engine has two cylinders arranged tandem, all being of the Otto cycle and acting on each side of the piston, thereby giving the 60 and 100-hp engines an impulse every revolution and the 150-hp engine two impulses every revolution when working under full loads.

A convenient way of starting these large gas engines has always been quite a mechanical problem. In some instances, after the engine has been started first of all by pumping an explosive mixture into the cylinder, or by some other means, and igniting it, the engine furnishes power for running the dynamo and storing up electric energy in a storage battery for future use in starting; then the storage battery furnishes power to run the dynamo, and the dynamo starts the gas engine. But the American Gas Engine Electric Company have their engines constructed so as to pump air and compress it into a reservoir, using it as a means for starting their engines.

This paper so far has dwelt to some extent upon the gas engine of the past and present, and it may be in order to consider the gas engine of the future.

The engines should be designed so that their gases can be expanded down to atmospheric pressure. More of the heat that is lost through the walls of the cylinder and out through the exhaust port should be utilized.

In governing the engine the gas and air should be reduced in the proper proportion so as always to make a combustible mixture. The engine should be designed so that its motion can be reversed. The engine should be made single and double acting. The gas-producing apparatus should be developed so as to have a cheaper gas. I have mentioned above that the usefulness of the gas engine of to-day was due to the successful introduction of the compression principle, but it can be no further advanced through this source. An increase of the compression beyond what is now used increases the negative work of the engine and also the friction, and would require a larger engine for any given amount of power; so its further advancement through this source is impossible and must be developed on the lines such as I have mentioned.

The pressure at the time of the exhaust of a gas engine is equal to the initial pressure of some steam engines, and by expanding these gases down to atmospheric pressure the practical efficiency would be increased from 16 to 25 per cent., and the disagreeable noise which occurs at the time of every exhaust would be abolished.

The heat generated in a gas engine at the time of explosion amounts to about 1600 degrees C., a temperature about 390 degrees above the fusing point of the cast iron of which the cylinder is made. As the air is a slow conductor of heat, there is enough converted into useful work to make the gas engine a success, but a great deal is absorbed by the walls of the cylinder, and a great deal passes out of the exhaust port. It is admitted by every authority that fully 51 per cent. of the heat is lost to the walls of the cylinder, 31 per cent. is carried away by the exhaust, 2 per cent. is lost by radiation, etc., leaving 16 per cent. of indicated work done in the cylinder.

What is carried away by the exhaust can only be saved to any very great extent by further expansion, but the amount absorbed by the walls of the cylinder can be saved in several ways. The engine should be run at as high speed as possible, so as to shorten the time that the gases are in contact with the walls of the cylinder; and the walls of the cylinder should be kept at a comparatively high temperature, so as to reduce the amount of heat absorbed from the combustion of the gases. The flow of cold water around the cylinder reduces the efficiency considerably, and its use should always be avoided, but every gas engine requires a water jacket to carry off the heat absorbed by the cylinder walls, and what is carried off in this way is lost. A space might be left with a capacity as large as that of the cylinder, through which the air could pass to the cylinder, and in this way some of the heat could be conveyed back to the cylinder to do useful work, thereby increasing the economy of the engine. However, some maintain that there is as much lost as gained, owing to the expansion of the air before it enters the cylinder.

The production of an engine that could be successively reversed would be a feature greatly in favor of the gas engine. This has been done on small gas engines, where large fly-wheels are not requisite, by connecting a reversing lever to the electric sparking mechanism, so as to explode the gases just before the piston arrives at the centre of its compression stroke, thereby overcoming the momentum of the machine, and finally reversing its motion.

The further introduction of the gas engine depends very greatly on the development of the gas-producing apparatus, which of late has made some advances. Heretofore illuminating gas has always been used. Producers' gas has been used to some extent, but is inferior to illuminating gas in not having the heating power, and has the disadvantage of gumming the cylinder.

The single-cycle gas engine, like the Lenior in 1860, is appearing above the horizon, and has already been introduced to public use. While it has many advantages, it also has a very low economy. The extravagance is due to the charge being too greatly adulterated with burned and inert gases, or the loss of gas by its following the burned gases through the exhaust port when too much air and gas are allowed to enter the cylinder. This was well demonstrated in the motocycle tests recently made in Chicago. Among the gasoline engines used two were of the single-cycle type. The exhaust from these engines was so densely laden with unconsumed carbon that an exhaust pipe and fume blast were required to convey the fumes from the testing room. A single-cycle gas engine designed somewhat on the order of this sketch would give very good results, and particularly for driving electric machines.

* Abstract of a paper read before the Chicago Electrical Association, March 20, 1896.

The National Electrical Exposition.

In addition to the list of names of exhibitors at the National Electrical Exposition, which opens in New York City on May 4 next, the following have been handed in: American Electric Heater Corporation, Boston, Mass.; Anchor Electric Company, Boston, Mass.; Bourne, Scrymser & Co., New York; J. T. Case Engine Company, New Britain, Conn.; De Veau & Co., New York; Electrozone Company, New York; Fort Wayne Electric Corporation, Fort Wayne, Ind.; Interior Conduit & Insulation Company, New York; Metropolitan Telephone & Telegraph Company, New York; New York Safety Steam Power Company, New York; Schiff, Jordan & Co., Vienna, Austria; A. M. Searles, Chicago; Spon & Chamberlain, New York; Syracuse Storage-Battery Company, Syracuse, N. Y.; Tellmic Manufacturing Company, New York; Thomson Meter Company, Brooklyn, N. Y.; Warren Electric Company, Chicago; Watertown Engine Company, Watertown, N. Y.; Wendell & McDuffie, New York.

Central-Station Working—XIV.

The Boiler Room.

BY L. H. THULLEN.

In the past electric lighting was conducted on lines impossible under modern conditions as to time and competition. The time of speedy construction and haphazard running of central stations is a thing of the past. Considerable improvement has been made in electrical apparatus installment and management of central stations in the last few years. Economy and continuous service should be the object of all managers. Fuel, interest on investment, depreciation, labor and lamp renewals are five very important items that enter into the running of any light and power plant.

Some superintendents in striving to obtain a high fuel efficiency, neglect the other four items, and the result is an expenditure of a dollar and ten cents in the latter in order to save one dollar in fuel. Attempted economy of this kind shows up poorly in dividends. Others, in striving for economical working, are continually discarding good apparatus for something just a trifle better in efficiency (so claimed by the manufacturers). This requires frequent investments for the stockholders and proves very poor economy at the end of five or ten years. A painter once claimed that he could paint a smoke-stack blue and show a saving of 5 per cent. Moral?

The use of poor and inefficient machinery is not hereby advocated, but extensive changes involving large expenditures of money are not economical, for such changes generally require more labor, and the gain in all-around economy is small.

The boiler room is the starting point in economical working, and everything in it should be designed with that end in view. The boiler should have a high efficiency, small depreciation, be reasonable in first cost and require a minimum amount of labor. The different kinds and makes of boilers from which to choose are quite numerous. Water-tube boilers will be found well adapted for a working pressure above 150 pounds; the horizontal return tubular boilers are excellent for pressures below this point; this class can be built for working above 150 pounds pressure, but they must be well designed and of superior workmanship; they have the advantage of low first cost, combined with a high efficiency and small depreciation, and with good care will run a number of years with a small repair account. They can also be easily kept clean, and will give very little trouble in their operation.

The use of mechanical stokers will greatly reduce fuel consumption and labor. We installed the Acme stoker in our plant and have noticed the following results: 40 per cent. decrease in the fuel bill, less labor, a more steady steam pressure, and less wear and tear on the boiler and settings.

By firing with a stoker a cheaper grade of fuel can be used, which will greatly reduce the fuel bill; also they are practically smokeless, which is an item of considerable importance, especially in a large city.

A smoking stack is an evident sign of poor economy. Smoke is caused by imperfect combustion of fuel, caused by either the temperature of the furnace being too low, or a lack of air, or both. A good way to obtain a higher temperature in the boiler furnace is to construct a substantial arch of fire-brick over the fire doors and extend it back several feet over the fire; the gas coming in contact with the hot fire-brick will be more readily ignited.

A hollow bridge wall with air entering it from the back of boiler through air-ducts in the walls, or through one or two boiler tubes, will furnish hot air to mingle with the furnace gases, and assist in complete combustion.

Fig. 1 shows a boiler set with a mechanical stoker, hollow bridge wall, *A*, with hollow space 36 x 21 x 4 inches, and nine openings, 4 x 11 inches, in front of bridge wall, as shown in Fig. 2. Also a six-inch iron-pipe (boiler tube) *B*, in Fig. 1, to bring cold air from rear of boiler to bridge wall. The air coming through the pipe is heated very hot by coming in contact with the hot bricks in the bridge wall. The iron pipe will not be affected by the heat, owing to the circulation of air. An air space that would be very satisfactory could be made in the side walls to conduct air to the bridge wall. The pipe construction is intended for boilers already set, while the space inside of the walls is preferable for boiler settings under construction.

C, in Fig. 1, is a ⅜-inch gas pipe in which are drilled three $\frac{1}{16}$-inch holes through which steam enters the furnace, and assists greatly in the combustion of smoke, besides keeping the grates free from cinders and improving the draft. Tests made with this steam jet show a slight economy in favor of its use, and also a higher furnace temperature and more consumption of fuel per square foot of grate surface. *D*, Fig. 1, is a large fire-brick arch which extends back over the grates and materially assists in the working of the furnace.

The results to be obtained from a good draft cannot be overestimated, for upon the draft depends the amount of coal consumed per square foot of grate surface; it also aids in the consumption of smoke, prevents the coal from cindering and keeps the grates much cooler, thereby preventing the grate bars from warping.

Sixty to seventy per cent. air space in grates is none too small where run of mine coal is used. Where a stoker is not used good shaking grates will be found to give very satisfactory results, as the fire can be kept cleaner and brighter by their use.

It is a well-known fact that a boiler worked at full capacity is more economical than at partial load; a few boilers forced for a few hours during the peak of the load are more efficient than running a number of boilers at full capacity for a few hours during full load and then running at under capacity or banking the fires the remainder of the time. A boiler that is kept clean is not injured by forcing it for a few hours.

Good stack draft is very necessary to force a boiler and forced draft may be used without injury or lowering the all-day efficiency of the plant. Water in the ash pit will aid the draft, prevent cinders from running on the grate bars and prolong the life of the grates. A clean boiler is one of the essential things in the economical running of a light and power plant, as one eighth inch of scale will lower the efficiency of a boiler 20 per cent. and cause numerous repairs and shut downs. Kerosene used in a boiler is a great scale preventative One quart per day per 100 horse-power, fed into the boiler with

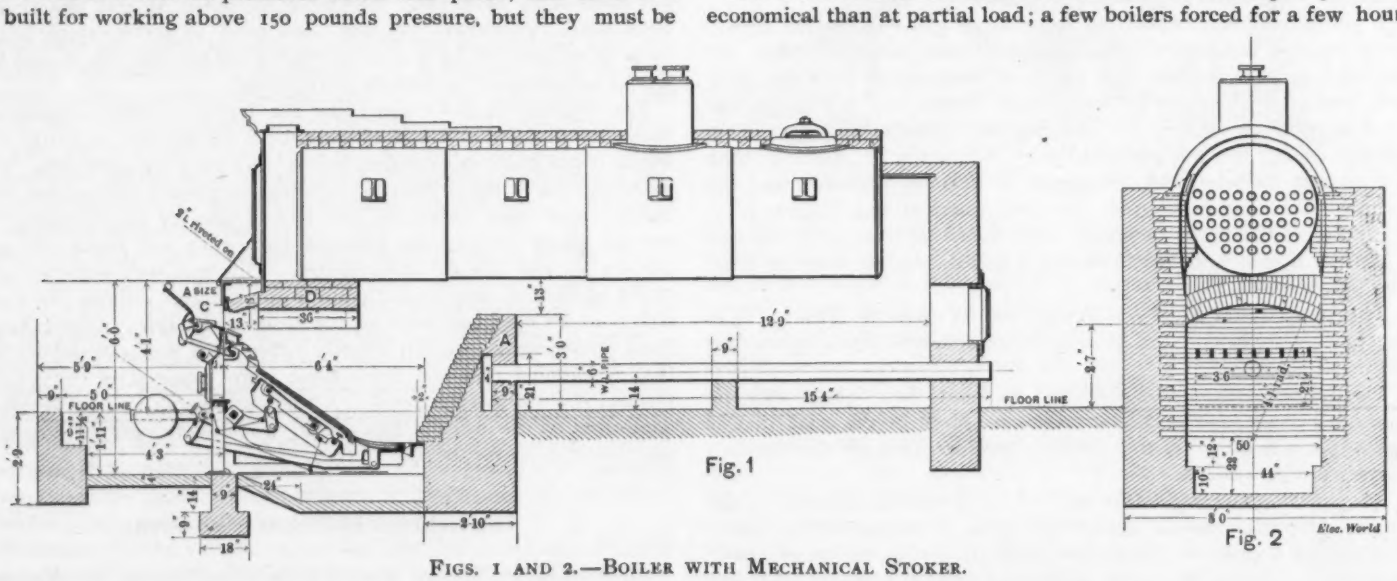


Fig. 1 Fig. 2

Figs. 1 and 2.—Boiler with Mechanical Stoker.

feed water one drop at a time, will entirely prevent scale forming and will loosen all old scale.

We have used this remedy for a number of years; our boilers have been in use seven years, are now free from scale, have not a single leak, and have never cost us a dollar for repairs. The kerosene not only keeps the boiler free from scale, but is a benefit to it, as oil keeps iron from being pitted where there is sulphur or other deleterious matter present in the water. There are a number of good scale resolvents on the market, but care should be taken in using them, as some have a tendency to eat the iron. We have used several, but have found kerosene to be by far the best and cheapest. If a boiler is blown off once a day, the mud formed by the dissolved scale will nearly all blow off, leaving very little to take out on boiler cleaning day.

"Keep your boiler clean" is a good motto to follow, and one which will result in greater fuel economy and a decreased repair account.

Telephony and Involved Interests.

BY E. F. FROST.

From the inception of the telephone enterprise in 1876 until late in 1879, there were two active competitors in severe antagonism for the monopoly of the whole telephone business. These competitors were the Western Union Telegraph Company and the American Bell Telephone Company.

As the result of suits at law and for various other reasons, both companies found it convenient to enter into an iron-clad agreement—the now famous contract of 1879. This agreement or contract, having a life of 17 years, and therefore expiring in November of this year, secured to the American Bell Company the monopoly of the telephone business on the conditions that the Bell Company should refrain from telegraphic work, from the telephonic transmission of dispatch business and from the handling of press news matter; also on the condition that the Bell Company should pay to the Western Union Company 20 per cent. of the net telephone receipts. Provisions were made for a possible renewal of this contract.

If we look into the past of telephone matters, we shall see that the security to both companies in this contract rested wholly in the power of the Bell Company to base its monopoly on the fundamental Bell patents; for because of these patents no competitor of the Western Union Company could undertake long-distance telephony for the handling of news or dispatch work.

While by this contract between these two corporations the Western Union Telegraph Company tried to limit the distance over which telephonic messages should be conveyed, yet the Bell Company has not only managed to parallel with its long-distance telephone lines the Western Union telegraph lines throughout the Northeastern section of this country, from Maine to Minnesota and South to the District of Columbia and Kentucky, but also without opposition it is enabled to handle press work as well as dispatch business, for which it charges rates as per Western Union scale.

Let us now discuss the possibilities of the long-distance telephone interests at the expiration of the 1879 contract.

The continuance of the Bell Telephone monopoly now depends upon the validity of the Berliner patent of 1891. The coming trial of the appeal of the United States against the Berliner patent before the Supreme Court of the United States will not go into the merits of the Berliner patent only in so far as such merit has been brought before the lower courts. Therefore defeat of the government will not mean absolute security to the Bell Company whereas defeat of the Bell Company will mean an end to its monopoly.

We have therefore to consider the telephonic possibilities, with the Bell Company continued in its monopoly, and with the monopoly destroyed.

Under a continuance of the Bell telephone monopoly, what is the probability of a renewal or extension of the Western Union-Bell contract? It is hardly to be expected that the Bell Company will continue to pay the Western Union Company 20 per cent. of its net earnings; for the same conditions do not now exist as obtained in 1879. Nor is it likely that the Bell Company will choose to be limited in the nature and extent of its business; for it is in a position by means of its long-distance lines to enter into active competition for the ordinary telegraphic work. This would produce a battle royal with the advantage on the side of the Bell Company to the jeopardy of the great vested interests of both the Western Union and Postal Telegraph Companies.

The possibility of an amalgamation of the Bell and Western Union Companies under a continuation of the Bell monopoly, while worth consideration for stock-jobbing purposes, would not be apt to take place because the value of the Western Union plant to the Bell Company would not be commensurate with its value to the Western Union Company. Much less would there be a likelihood of an amalgamation of the Bell, Western Union and Postal Companies.

It is therefore of chief interest to the Western Union and to the Postal Companies to see that the Bell monopoly is not continued if such be in their power.

If now the Bell monopoly be destroyed by reason of the invalidity of the Berliner 1891 patent, what are the telegraphic and telephonic possibilities?

Let us at once dispose of the numerous telephone companies now in the field striving to compete with the Bell Company—such as the Harrison, the Standard, the Home and others. These companies can be of but little importance as competitors because there is not the incentive to their success essential to bring capital sufficient to meet the demands of so gigantic a competition. The only incentive they possess is that of the possibility of gain under impossibly favorable circumstances. They have no large vested interests at stake which would make it essential that capital should hurry to the rescue and safety of such interests under adverse circumstances. These companies have everything to gain and but little to lose.

On the other hand, the vested interests of the Western Union and of the Postal Telegraph Companies are of such magnitude and importance that it is absolutely essential that, the Bell monopoly being destroyed, these companies take measures to protect their interests against the advent of a new competitor for their business—a competitor, the Bell Telephone Company, so well intrenched and established that on the day of the expiration of the Bell-Western Union contract thousands of offices can be thrown open for the dispatch of telegraphic and telephonic business between the important news and business centres at rates far below those now in force.

It is not to be presumed that each of these companies is not fully alive to the possibilities and necessities of the situation; but it is not without importance to discuss the conditions which each of these interests have to face in the near future.

Therefore the telephone monopoly and the Bell-Western Union contract being expired, what are the probabilities of this contract being renewed?

The conditions now are such that this contract would not prevent the Postal Company, or any other company, for that matter, from undertaking long-distance telephony in competition for dispatch work, and therefore such contract would only handicap the Western Union Company in its business. Therefore such contract would have to be modified and the Postal Company taken in; and by reason of gigantic power such a combination would have to monopolize the field in order to hold together.

There is a possibility of an amalgamation of the Bell and Western Companies, but in this case they would be compelled to face the competition of the Postal Company and the influence of such other interests as would be antagonized.

The Postal Telegraph Company, as a competitor of the Bell and Western Union Companies, whether combined or not, is of no small concern, for to protect its interests of necessity it must go into long-distance telephone work. The strength of the Postal Company as a competitor would reside, not in the strength of its vested capital so much as in the necessity that certain great interests of this country should not be subject to a monopoly of the telegraphic and telephonic business. It is these interests which, even if the above-mentioned three companies were to consolidate, would be compelled to enter the field in competition for its own protection.

This interest is the newspaper press of this country. The same necessity which achieved the construction of the press cables to Europe will construct its long-distance telephone lines across this continent, for it will not suffer itself to be at the mercy of any monopoly, there being no legal necessity for it. The gathering of news is of that importance which will warrant the establishment of a long-distance press telephonic and telegraphic system to include every news centre in this country. This system would be entirely distinct from the local telephonic and telegraphic interests. Nor would it necessarily encroach on the dispatch business of the telegraph companies, except as competition should cause retaliation; for should it become necessary to retaliate upon the telegraph companies it would only be necessary to undertake dispatch work. Should it become desirable to antagonize the Bell Company it

would only be necessary to radiate local telephone lines at each news centre.

Therefore, we may look for a great struggle in the near future between these great interests, the outcome of which will be to the advantage of the press and possibly to the business world at large.

It is conclusive from the above that it is of vital importance to American newspaper interests, whether they have yet realized it or not, that the Bell Company should not be sustained in its monopoly. Every energy of this great power should be brought to bear to achieve the end of the telephone monopoly, if such can be done in justice and in equity.

Electric Fans.

BY S. D. MOTT.

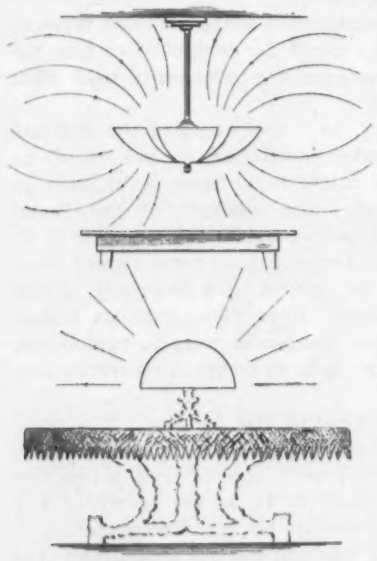
The subject of creating an artificial breeze in the Spring may seem very much out of season in our latitude ; at the same time, on the other hand, no one will deny that the proposition will be a welcome one further down the calendar of 1896, and as preparations for manufacturing the season's supply of coolers must be taken into account, the subject of this writing may not be inappropriate at the present time.

I believe that the design of an electric fan, like kindred devices of convenience, necessity, or luxury should not only be good, as a machine and a thing of utility, but be ornamental as well and a thing of beauty, as far as may be.

The ideal ventilating fan to my mind, like ventilating systems of greater magnitude, should circulate the air in gentle movement rather than cyclonic blasts, and this I believe, if accomplished in a simple manner, would be preferable to the majority of users.

To do this I would take the ordinary electric motor of preferably spherical design, and instead of making it for fussy activity in straight lines I would load it down with a larger screw surface, and of a shape which would impel the air in radial and radiating lines, either downward or upward from the centre of disturbance. To effect this result I would form the blades of the screw, or the screw as a whole, from a hollow hemisphere of metal, instead of a flat sheet, or cause them to be so formed after being made in the usual manner. By doing this we have to a greater or less extent a part spherical, instead of a flat plane of revolution, the advantages of which, aside from novel and handsome design are, (a) compactness with greatly increased effective screw surface, (b) better circulation, (c) diffused air currents, (d) ornamental configuration.

The idea illustrated in the accompanying cuts is to disperse the air in a way to promote its best circulation. If Fig. 1, for instance, were placed in a vessel of water it will be apparent that as perfect a circulation of the fluid contents would take place as could be produced, whereas if we place the ordinary propeller in the vessel of water it would churn and agitate, but circulate the contents very imperfectly.



Figs. 1 and 2.

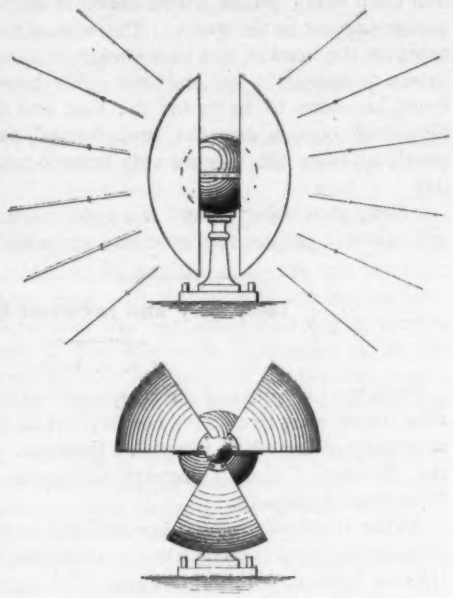
Much the same results could be attained by making the blades of greater width than usual and forming them so that the cutting or front edge will, when in motion, describe substantially a flat plane and the rear edge a path which may for convenience be described as approximately a hollow hemisphere.

The *raison d'ètre* of the ball nozzle is the simple way it has of dispersing a normally concentrated jet of water or air.

The swivel motor fan, which while the screw is revolved on its axis in the usual way causes, gyroscopic like, its revolution around its point of support, directing its breeze in a circular sweep, is here improved in a plain, simple way, which is cheaper to construct, while no more expensive to operate, and diffusing the air from a centre of disturbance instead of directing it in circular intermittent blasts.

Fig. 1 shows a fan adapted for use in restaurants which would circulate the cooler air, instead of churning the hot air and transferring it when it is not desired. It may be constructed on the drop plan so as to be raised or lowered as desired, and while acting as a cooler be a scare-fly at the same time.

Fig. 2 is an ornamental air-circulator for city clubs, banqueting tables, etc., to be made sufficiently ornate in design to insure it a place in the homes of wealth. Electric fans have a very limited use at present in such places, but air-coolers of artistic design, to be operated with flexible cord from chandeliers or otherwise, and which would act at the same time as air-coolers and circulators, should meet with consideration in a city like New York. When made and operated in the ways proposed it would need no such abomination as a protecting screen.



Figs. 3 and 4.

In Fig. 3 the device is planned with two screws on each end of a horizonal axis for circulating the air currents radially as from a centre. The pitch of the screws in this instance being set oppositely, if the pitch of the screws conform the air currents radiate from and to the centre of disturbance.

Fig. 4 gives a view of the fan in elevation on the axial line showing the slight deviation from conventional forms. In the illustrations the planes, or, more strictly speaking, paths of revolution, are indicated.

Lord Kelvin's Jubilee.

The following interesting communication has been received by the National Electric Light Association, at its headquarters in this city:

JUBILEE OF THE RIGHT HONORABLE PROFESSOR LORD KELVIN.

Glasgow, March 10, 1896.

Sir:—In the Autumn of this year the Right Honorable Lord Kelvin completes the fiftieth year of his tenure of the Chair of Natural Philosophy in the University of Glasgow. An event so rare in academic history naturally calls forth the heartiest congratulations of the university and the city; but, in view of his pre-eminent position as a man of science, it has been thought fitting that other bodies who have already testified their appreciation of Lord Kelvin's distinction by enrolling his name among their members, should be invited to take part in the proceedings with which it is proposed to celebrate the jubilee of his professorship.

We are desired by the committee charged with the arrangements to intimate that the university and the municipality would be gratified by your appointing a representative to take part in the celebration to be held here on the 15th and 16th of June next. Be so good as send to Prof. Stewart, Clerk of Senate, the University, Glasgow, not later than April 10, the name and address of your representative, in order that a formal invitation may be forwarded to him.

We have the honor to be, sir, your obedient servants,

John Caird,
Principal and Vice-Chancellor of the University.
James Bell, Bart.,
Lord Provost of Glasgow.

We are informed by Secretary Porter that President C. H. Wilmerding has appointed Mr. Thomas Commerford Martin to represent the association on this occasion.

Practical Application of Röntgen Rays.

A practical application of the use of Röntgen rays is, according to the London *Electrician*, to be found at the Faraday House, Charing Cross Road, where patients, accompanied by a physician, may be examined.

The Chemical Theory of Lead Accumulators.

BY MAURICE BARNETT.

Up to the time of the introduction of the Faure cell, and during the years immediately following, the theory advanced to explain the action of the lead accumulator was that the oxygen and hydrogen, dissociated during charging, were occluded at the electrodes—oxygen at the positive and hydrogen at the negative; and that these, on recombining, produced the phenomena of discharge. Considerable plausibility was lent to this view because the activity of the Grove gas battery was known to be due to the recombination of the gases covering the electrodes; the greater capacity of the lead cells being explained by the larger surface offered by the very porous active material of the electrodes. Under this view sulphuric acid was supposed to be present merely to give conductivity to the water which was believed to be the real electrolyte. To see the fallacy of this, it is only necessary to look at this question from the standpoint of thermo-chemical principles.

When dilute sulphuric acid is electrolyzed with platinum electrodes the dissociation of oxygen and hydrogen is accompanied by an absorption of energy. When these gases recombine they yield the same energy that was spent in separating them, less that lost in overcoming resistance. Now, as a current of 1.5 volts, approximately, is needed to break asunder the affinity of oxygen for hydrogen, it follows that these gases on recombining will develop the same E. M. F. This result could be anticipated from the fact that 34,180 c. g. calories are liberated when oxygen combines with hydrogen to form water. According to the method shown by Sir W. Thompson (Lord Kelvin) for calculating volta-motive-force from chemical heat of union this energy corresponds to an E. M. F. of 1492 volts. In the lead accumulator we have under normal conditions the manifestation of an E. M. F. of at least two volts during the greater part of the discharge, so that something more than the tension produced by the occlusion of oxygen and hydrogen is necessary to explain the E. M. F. of secondary cells. The "occlusion" theory fell to the ground in 1882, when Messrs. Gladstone and Tribe demonstrated that, of the hydrogen liberated in charging, only traces were absorbed at the negative electrode. In 1883 Dr. Frankland confirmed this by proving that neither oxygen nor hydrogen was occluded during charging.

Although the occluded gas theory was strongly held up to 1882, it was inevitable that there should be some recognition of the fact that during discharge the active material of the electrodes underwent change. Planté, a believer in the "occlusion" theory, had already observed the reduction of the peroxide and oxidation of the metallic lead at the positive and negative electrodes respectively, likewise the formation of films of sulphate on the grids and throughout the active material of the positive plate, which latter action he ascribed to local action between the peroxide and its support. In a series of articles begun in May, 1882, in the *Engineer*, London, Dr. O. Lodge, while still holding to the occluded gas theory, recognized the reduction of PbO_2 to PbO during discharge as an essential reaction contributing to the activity of the cell, also the formation of lead sulphate arising from the action of the electrolyte on this oxide. He called attention further to the formation of films of sulphate on the negative plates occurring, as he thought, simultaneously with the exhaustion of their hydrogen. These films of sulphate were supposed to be formed on the surface and to extend inward. Their formation being considered hurtful to the cell, he was led to advise the use of a limited amount of acid in the electrolyte as calculated to minimize this action as far as possible.

The theory which is generally accepted to-day as affording a correct explanation of the chemical changes taking place in the accumulators comprehends the conversion of both electrodes into sulphate during discharge and their regeneration to metallic lead and peroxide with formation of sulphuric acid when the cell is reversed. These reactions, so far as the discharge is concerned, are represented by equations (1), (2) and (3). For the negative plate we have

$$Pb + H_2SO_4 = PbSO_4 + H_2 \qquad (1)$$

Action at the positive is supposed to take place in two stages; first a deoxidation, and then the conversion of the monoxide into sulphate.

$$PbO_2 + H_2 = PbO + H_2O \qquad (2)$$

$$PbO + H_2SO_4 = PbSO_4 + H_2O \qquad (3)$$

Writing reactions (1), (2) and (3) in one equation we have

$$Pb + PbO_2 + 2\,H_2SO_4 = PbSO_4 + 2\,H_2O + PbSO_4 \qquad (4)$$

On charging the action is reversed, and we have

$$PbSO_4 + 2H_2O + PbSO_4 = Pb + 2H_2SO_4 + PbO_2 \qquad (5)$$

The formation of sulphate at both electrodes being recognized, it followed that sulphuric acid and not water was the electrolyte and that the formation of sulphate of lead at both electrodes constituted the natural reactions upon which the activity of these cells depends. This view was affirmed by Messrs. Gladstone and Tribe during 1882 as a result of their investigations into the chemistry of accumulators, investigations which were the most thoroughgoing and comprehensive made up to that time.

If this view was correct it followed that Dr. Lodge's suggestion to have but little acid in the electrolyte was unwise; the correct procedure being to have plenty of electrolyte of sufficient density so that the abstraction of acid during discharge would not reduce the strength of the remaining solution. The most recent practice in this respect is to employ acid, say of 1.3 sp. gr. The resistance of this being lessened by dilution, it follows that as the cell discharges its internal resistance will grow smaller; and the voltage which naturally tends to fall during discharge will thus be held up. Gladstone and Tribe further called attention to the phenomena previously noticed by Planté that local action takes place between the active material and its support and showed that this was of the same nature as the essential reactions of the cell and was attended likewise with the production of sulphate.

With reference to local action between the active material and the support in the positives, it was thought that this led to the disintegration of the grids. Gladstone and Tribe shared this notion, and believed that the prevention of this was to be found by leaving intact the film of sulphate that covered the grid; and they protested against overcharging, as this reduced the film in question. Later investigators, among whom may be mentioned Messrs. Drake and Gorham, dissented from this and found that the film of PbO_2 formed from the $PbSO_4$, on charging, was the real protective coating. According to this view some overcharging was beneficial, as it promoted the formation of this peroxide film, besides tending to bring all the active material into this condition.

The double sulphating theory of Gladstone and Tribe was not accepted without a protest. The non-conductivity of lead sulphate and the difficulty of reducing it made it seem highly improbable that the activity of the cell was due to such a reaction. Experiments carried on both by Lord Kelvin and Dr. Lodge, looking to the reduction of pure lead sulphate with platinum electrodes in sulphuric acid, had not succeeded; and even Gladstone and Tribe had admitted that under such conditions it was only possible to effect a partial reduction after days of electrolytic action. That this reduction should take place instantaneously in the lead accumulator was inexplicable.

We shall see later on that this difficulty is explained away by the presence in the electrodes of sulphates with conducting qualities, which represents a different condition from that obtaining in the Kelvin-Lodge experiments.

Up to this time all researches into the action of secondary batteries had been restricted to the qualitative and quantitative changes taking place at the electrodes. The electrolyte, however, was soon to become the object of careful investigation. In May, 1889, Messrs. Duncan and Wiegand in a communication to the American Institute of Electrical Engineers, covering the results of experiments which they had been making into the physics of secondary cells, showed that during discharge the electrolyte permeating the active material of the electrodes was weakened by the abstraction of sulphuric acid faster than it could be equalized by diffusion. In 1890 Prof. Ayrton published results of investigations which included among other things the study of the changes of temperature taking place in accumulators during charge and discharge and brought out the fact also noted by Duncan and Wiegand that these cells remained cool while discharging. Investigations into the relation of the electrolyte to the E. M. F. from the point of view of the strength of the acid were published in 1890 by Messrs. Gladstone and Hibbert. In 1891 G. H. Robertson and Prof. Armstrong called attention to the occurrence of persulphuric acid in the electrolyte and questioned whether the variations of E. M. F. and other changes in the cell might not be explained by the presence of this compound. Mr. Robertson took up this matter more in detail during the same year. In 1892 Messrs. Gladstone and Hibbert, taking as the basis of their arguments the facts brought out by Duncan and Wiegand, endeavored to prove that all the variations in the discharge of secondary cells could be explained by the varying strength of the acid around the electrodes.

(To be continued.)

Fly-Wheel Governors.

BY GEORGE T. HANCHETT.

Among the most successful governors for steam engine regulation are those attached to the fly-wheel and revolving with it. Engines using this type of governor are of necessity high-speed engines, for at slow speeds such a governor would not possess sufficient power to vary the position of the eccentric unless the parts were very heavy. On the types of detaching valve gear the ordinary pendulum governor, susceptible of being driven at high speed, is preferable, as it is sensitive, and the necessary power for its operation is slight.

This article has to do with fly-wheel governors and some of the principles of their design. Two separate actions may be brought into play for regulative purposes on a fly-wheel governor. Curiously enough, neither of these actions is classed by physics as a force, although in this case the resultant motions give evidence to the more than casual thinker confirming the existence of actual forces. The first of these actions is that due to the tendency of the governor weight to move in a straight line, while the confining parts are caused

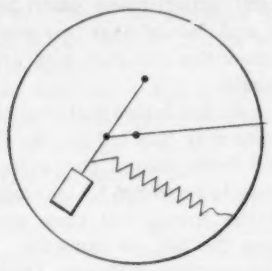


Fig. 1.

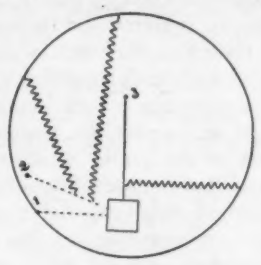


Fig. 2.

to move in a curve. This results in a powerful tendency of the weight to describe a larger circle, as more nearly approaching the motion prescribed by Newton's first law. In other words, this action is the so-called centrifugal force. The second action present with every fly-wheel governor is the tendency of the weights to keep an unvarying speed. Any change in the speed of the fly-wheel, either faster or slower, tends to alter the relative angular position between the governor weights and the wheel itself. This inertia action is present with every fly-wheel governor. In some cases it actually moves the governor mechanism, while in others the pressure comes squarely on the pins and no motion of the parts occurs.

Some designers of the more recent types of governors have noted and utilized this action, but many governors have been built with the idea of controlling by centrifugal force alone. Sometimes by sheer "bull luck" the inertia action has assisted the action of these governors, while in other cases it has been the unrecognized cause of poor action. In examining mathematical discussions on fly-wheel governors the writer has found this factor completely ignored where its action was so apparent as to render the whole discussion worthless.

On a fly-wheel governor there are four distinct forces tending to move the mechanism:

First: The so-called centrifugal force, a constant when the speed is constant and the position of the parts is unchanged.

Second: The tension of the springs, which is constant so long as the position of the parts remains unchanged.

Third: The inertia action, dependent for its magnitude upon the variation in speed of the engine, and present only while the speed is changing.

Fourth: The pull of the valve rod upon the mechanism, a variable and incalculable factor.

The last factor is a most objectionable one, and should be eliminated as far as possible by so designing the mechanism that at the points where the valve rod is being moved, the pull comes directly against some rigid pin, while at times when the valve is in positions of comparative rest, the governor mechanism passes a position where a pull along the line of the valve rod would most affect it. This principle can be more clearly seen by considering Fig. 1.

The line of eccentricity is such that when the valve rod is stationary, the governor is in its most susceptible position to a pull along that line. When the valve rod is at its greatest motion, the line of motion passes through a fixed point, and the governor mechanism is now rigid to a valve rod pull. By a little ingenuity in construction, this rigid position can be obtained at any angular position of the fly-wheel. Thus, the greatest pull of the valve rod can be directed upon the pivot, and thereby largely relieve the governor of its influence. By increasing the power of the governor by suitably increasing its weights and balancing springs, the pull of the valve rod may be made more nearly negligible.

The inertia of the weights is an important factor often neglected in mathematical discussion. Considering the simple governor of Fig. 1 once more, if it revolve in the direction of the arrow as shown, centrifugal force will exert a constant strain on the spring as long as the speed is constant. If, however, the speed varies—say becomes reduced—the centrifugal force will also be reduced, and the spring will draw in the weight and change the eccentricity. But another and more powerful force, due to the tendency of the weight to keep up its speed, will move the mechanism, working in conjunction with the centrifugal force. If the direction of rotation were reversed, the inertia action would work against the centrifugal action, and cause the engine to hunt on a sudden change of load. In spite of this fact, engine governors, in which the inertia effect and centrifugal effect oppose each other, are built, either in ignorance of the above principle or with some other end in view. Such governors often have a dash-pot to prevent sudden changes, and thus damp the inertia effect, which only acts when the speed is changing.

Some governors are built with the two forces, centrifugal force and inertia effect, coincident in tendency, whether unknowingly or otherwise, and a much better regulation results. A few makers have recognized the great power of inertia as a regulating factor, and have incorporated it in their governor. Such governors are remarkably sensitive and powerful, while they have none of the racing tendencies of an isochronous centrifugal governor.

Force due to inertia on an engine governor may cause it to assume three different positions. It may assume a maximum outward position or a maximum inward position, according as the tendency of the governor weight is to lag or lead, and whether the pivot of the weight arm lies inside or outside a tangent to the circle of rotation of the weight at the centre of gravity, as shown in Fig. 2. The third position is directly on the tangent line, in which the radial component of the vis viva become zero. If, however, the governor weight starts from a position outside or inside the tangent line, it is very likely to overtravel this neutral position, and assume either one or the other of the extreme positions, as the case may be. If the change in speed is sufficiently quick, the governor will assume these positions in spite of centrifugal force or the force exerted by the springs. This will be evident from the following simple and familiar equation :

$$f = \frac{Wa}{g}; \text{ and as } a = \frac{V_1 - V_2}{t}$$

$$f = \frac{W(V_1 - V_2)}{g\ t}$$

If t be infinitely small, f will be infinitely great, and therefore the more sudden the change of speed, the quicker and more powerfully will the governor act. It is very important, therefore, to see that the vis viva is acting in unison with the regulation of the governor. Fig. 4 shows a governor in which the vis viva assists the regulation, while Fig. 3 shows a governor in which the vis viva is opposed to the regulation.

The first and second forces, centrifugal force and the force of the springs, should at all times nearly balance one another. Exact bal-

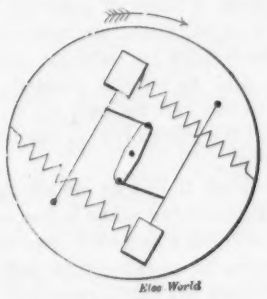


Fig. 3.

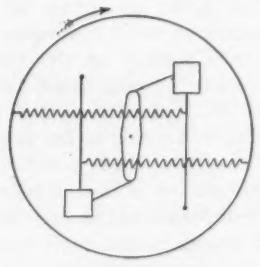


Fig. 4.

ance would produce unstable governing, but the condition should be as nearly approached as possible. The centrifugal force of the weights is equal to

$$f = \frac{W\ v^2}{g\ r}$$

In this formula v and r are the variables, and both increase together. Therefore, the restraining force should increase in strength in unison therewith. If we stretch a spiral spring, the force exerted is

$$f = d\ S$$

where d is the amount stretched and S the scale of the spring. If we place a spring at right angles to a governor rod, as in Fig. 4, the force necessary to deflect it will be in direct proportion to the angle de-

flected at that particular position and it will vary from that proportionately as the angle between the spring and the governor arm varies. If it is desirable to have the motion of the eccentric directly proportional to the speed, it is necessary to have the power of the spring increase more rapidly than the first power of the distance stretched. This may be accomplished by setting the pull of the spring on an angle with the governor rod. Noting the resolution of the forces in the case of Fig. 5, it will be seen that it is necessary to multiply by the sine of α in order to obtain on the governor-arm the force

$$f = S^1 d \cos \alpha ,$$

as in this position sin α is an increasing function, and therefore

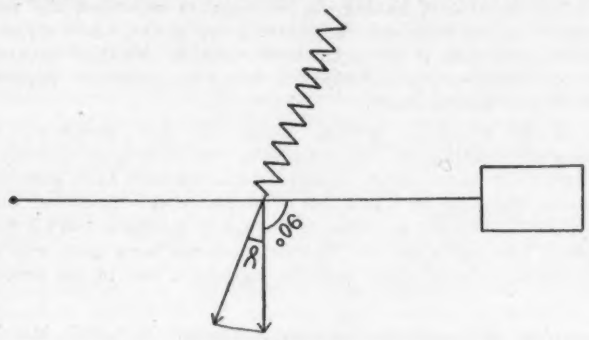


FIG. 5.

increases more rapidly than the first power of d. Proper calculation of the centrifugal force and its rate of increase as the governor passes through its various positions will best determine the initial value of α. The arrangement of valves will have much to do with the desired motion of the governor, but by this simple device a spiral spring may be made to give any counterbalancing effect desired within a wide range.

The Röntgen Ray Source.

BY ELIHU THOMSON.

Since writing my brief statement in which it was stated that the anode was possibly the source of the Röntgen rays within the Crookes tube, and not the cathode, I have continued my experiments and investigations, and have come to the conclusion that I was mistaken, the error being largely due to the particular structure of the tubes tested. Indeed, my later experiments have led me to this conclusion, which I think will require no amendment, namely, that the Röntgen rays are produced by the bombardment of any surface within the Crookes tube by cathode rays, or the radiant matter of Crookes; that fluorescence has nothing whatever to do with it, since substances which are bombarded and which do not fluoresce give out the rays—notably a piece of platinum. Lead glass which fluoresces less than German glass is still a strong source of the Röntgen rays when bombarded by the cathode rays. I have also been led to the conclusion that the more fluorescence there is produced by the bombardment the less energy will be available for Röntgen rays.

Another result of my observations has been to determine the fact that the Röntgen rays are emitted in all directions from the bombarded surface, and are not special to any particular direction. They are even emitted backward, towards the cathode from which the rays which bombard the surface are sent.

In my experiments I find a very convenient way to determine the direction of the rays to be a modification of the fluorescent screen. In this tube a small patch of fluorescent material is mounted at some point between the two ends of the tube itself, and backed by dark paper as usual. An opening for the eye is provided at one end of the tube, and a moderate size opening at the far end, or the one nearest to the Crookes tube, while the whole screen tube is made of metal, to prevent any lateral entrance of Röntgen rays. It will be evident that in this case when the eye and the fluorescent patch and the distant opening are in line with the source or point of emission of the rays in the Crookes tube, fluorescence will be obtained, but at no other position. Hence, when the tube is so pointed or adjusted that fluorescence is seen it is only necessary to follow back the direction of the tube to lead to the source of the rays. By changing the direction in which observations are made it is very easily seen that all of the directions determined will converge at some place which is the source of the rays. In this way it was found that with a small piece of platinum in the centre of the bulb upon which bombardment occurred from a concave cathode, such platinum became the source of Röntgen rays, and that it did not show the slightest trace of fluorescence.

It was also found that where the rays struck the walls of the bulb, whether the bulb was of lead glass or of German glass, Röntgen rays were emitted in all directions from the place struck by the radiant matter, and that when such rays were projected down and along the tubular extension from the bulb containing the cathode, and opposite which tubular extension the cathode was mounted, the sides of this tubular extension became a source of Röntgen rays, sent out in many directions, even in directions which were towards the cathode terminal.

Since experimenting with the special fluorescent screen which is mentioned above, I note that experiments carried out in an entirely different manner by Messrs. Scribner & McBerty have brought them to the same conclusion, and I also note that Prof. Stine has, by following still other methods of investigation, found that the rays are emitted from the bombarded surface. It is interesting, further, to find that, according to an account appearing in the *Electrical Engineer*, page 340, of an improved tube designed by one of the professors of King's College, London, the tube has a piece of platinum, which constituted the anode, and which becomes, when bombarded by the cathode rays, the localized source of Röntgen rays within the tube. I may say that one of the best tubes in my possession, and one which gave the sharpest image, had a piece of platinum foil mounted in the focus of the cathode rays, which platinum foil had become sagged or bent at an angle, its structure resembling the last-mentioned tube designed in London, except that it had a separate anode.

Röntgen Ray Nomenclature.

The following letters, in reference to the proper name to be given to pictures obtained by means of Röntgen rays, were received too late to appear in our last issue:

Prof. S. F. Whiting, Wellesley College, Wellesley, Mass.:

Radiograph would be my preference. The work is done by some form of radiant energy, and while this may be said of all photographs, this name has not yet been appropriated.

Mr. Herbert B. Schallenberger, Westinghouse Electric & Manufacturing Company, Pittsburg:

The proper name, in my opinion, would be "Röntgengrapa." It is too long, however, for common use. While it is rather mongrel, "rayograph" has shortness and ease of pronunciation to recommend it. I fear a good name is going to be difficult to find.

Prof. R. B. Owens, University of Nebraska, Lincoln, Neb.:

As the shadow prints made by the Röntgen rays are graphical records of electromagnetic or etheric radiations, I think they should be properly called "radiographs."

Mr. F. L. Woodward, Harvard University, Cambridge, Mass.:

In regard to the name which should be applied to the shadow-prints taken by Röntgen rays, I would say that the word "electro-sciagraph" seems to me to imply the most exact meaning. The only objection to it is that it is a rather long word.

Albert Sauveur, Illinois Steel Company, Chicago:

Of all the names which have been applied to the impressions obtained by the Röntgen rays, either sciagraph or sciagram seems to me the most appropriate. Since sciagraph is already used to designate sectional drawings of buildings, sciagram should be adopted for these silhouettes, in order to avoid any possible confusion. The only other names worthy of consideration are radiograph and scoto graph, but they are less exact, first, because all photographs are produced by *rays;* and second, Röntgen ray impressions are not truly made in the *dark*, since some fluorescence appears to be necessary to produce the effect.

Prof. W. E. Goldsborough, Purdue University, Lafayette, Ind.:

I can see no pertinent reason for making use of any word other than "photograph" in this connection, as this word applies equally well to all processes in which chemical change (due to radiant energy) is made use of in producing images. In my opinion, Röntgen photograph would in no wise be a misnomer. As, however, there seems to be an insatiable desire for a general increase in our nomenclature, I am of the opinion that the word sciagraph, from the Greek, meaning a picture in light and shade *only*, is the most appropriate, since it both conforms to the present scientific usage in such matters and conveys a correct impression. The present use of the word in connection with the representation of the sectional elevations of buildings will not conflict with the suggested application. I do not think scotograph so appropriate, as the more common meaning of the Greek "σκοτος" is that of *darkness* or *gloom*, or the shadows or dark *part* of a picture, and therefore refers rather to a *part* of the picture than to the *whole*.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Paralleling of Alternators. HAMMOND. Lond. *Elec. Eng.*, March 20.—The conclusion of his paper (*Digest*, last week); no general conclusions are drawn.

Recent Dynamos. Lond. *Elec. Rev.*, March 20.—A brief description of some recent forms constructed by Patterson & Cooper.

Sparking. HANCHETT. *Elec. Ry. Gaz.*, March 28.—An illustrated article on the sparking of closed-coil direct-current armatures, describing in easily understood language the various kinds of sparking, their causes and remedies.

Dynamos.—Elec. Power for March contains an elementary article by Mr. Sever on the design of dynamos and another by Mr. Pedersen on the field.

POWER AND HEAT.

Elevator to the Top of Mt. Blanc. *L'Eclairage Elec.*, March 14.—In a brief note regarding the proposal of Issartier (see *Digest*, Jan. 4) it is thought that the time of ascent will be about 30 minutes, and that it will require about 7 years to carry out the project, the cost of which will be about $1,600,000; he counts on a minimum receipt of $170,000 per year.

Electrically Operated Turrets. *L'Eclairage Elec.*, March 21.—An illustrated description of those on the Latouche-Treville.

Elevators. Lond. *Elec. Rev.*, March 20.—A continuation of the discussion of Mr. Gibson.

History of Electric Welding. RAVEAU. *L'Eclairage Elec.*, March 14.—A short article with special reference to the Hoho and Lagrange method. He states that the fusion of a wire in contact with a liquid was observed by numerous experimenters; a number of references to previous publications are given, among them is one dated 1844, stating that Havre melted an iron wire connected to the negative pole, and in contact with a solution of chloride of calcium; he concludes that there is therefore nothing new in this process as a phenomenon.

Mining Plant. *Eng. & Min. Jour.*, March 28.—A brief description of the plant about to be erected for the San Miguel Consolidated Gold Mining Company in Southwest Colorado; there will be two 800-hp, 500-volt quarter-phase generators, with a frequency of 120, connected directly with two Pelton water-wheels; the plant will include 12 Tesla motors of 50 horse-power each, 15 of 20 horse-power, a number of two-phase, three-phase step-up transformers; the line voltage will be about 11,600; it is thought that this installation will be the most complete electrical mining plant in the world.

Polyphase Plant at Guatemala. *Eng. & Min. Jour.*, March 28.—A note stating that the Siemens & Halske Co. have under construction a long-distance transmission plant for light and power purposes from a water-fall 22.5 miles distant; it is to be a three-phase plant, with a line voltage of 10,000. At present there is available 1300 horse-power; the maximum line loss is 10 per cent.

Mechanical Connections. CROCKER. *Elec. Power*, March.—A discussion of the practical nature of the various forms of gearing, including couplings and friction gearing.

TRACTION.

Accumulator Traction. FITZGERALD. Lond. *Elec. Rev.*, March 20.—He comments on the excessive weight of the earlier accumulator cars, which amounted to 12 and even 20.5 tons, and thinks it is not necessary to construct such ponderous vehicles; on the Paris line the accumulators weigh as much as 3 tons, but this does not explain the great weight of the completed cars; more recent data give as their weight 10 to 11 tons, the weight of the batteries having been reduced to 1.75 tons; he thinks this might be reduced; the results at Birmingham he considers very discouraging, and it reflects discredit on the inventors, makers and users of these appliances that they cannot, except under an additional expenditure of 173 per cent., obtain the very poor results in Paris, in which the cost per car mile was 15 cents, more than 3 cents of which is observed in the maintenance and attendance, which item he considers excessive; the explanation of it he thinks is very simple, and is that the accumulators are not adapted to the requirements of traction; the weight of the electrolyte has almost invariably been far in excess of what is required; the washing effect of the electrolyte on the plates may be entirely obviated by "a well devised afluidic system," which, however, he does not describe. An extract from a report of a French committee appointed to consider the various systems of traction states that while the negative plates show a remarkable durability, having exceeded 93,210 car-miles, the positive plates were quickly deteriorated, shedding the active material; to avoid the latter, a new form of plates has been adopted. He then discusses the subject of motor carriages, giving, however, little matter of importance; the article is to be continued.

Accumulator Traction. JEVOUS. Lond. *Elec. Rev.*, March 20.—A note regarding the Birmingham line, criticising the statement recently made to the effect that the Chloride Syndicate has recently been entirely successful with that line; he is at a loss to reconcile this assertion with the figures published by the last balance sheet, which show a loss for the year of $8500; a few years ago the Epstein batteries were used, which were followed by a profit of about $6000 as against a loss in the preceeding years.

Conductivity of Cement and Concrete. LINDECK. *Elek. Zeit.*, March 19.—A description of a number of tests made at the Reichsanstalt, with the results obtained of the resistance of pure cement and various mixtures of cement and sand; the object was to determine whether laying the rails of a railway on concrete foundations tended to diminish the resistance to the earth; the samples were tested under various conditions regarding moisture which they contained; in general it was found that the conductivity is relatively slight when quite dry; it is higher the greater the quantity of sand; but the porosity increases in about the same proportion; the resistance of a block after being in water for a day is only about one third the former resistance. He concludes that to place the rails directly on a concrete foundation diminishes the resistance between the rail and the earth, and therefore favors earth-return currents; this is specially the case when the streets are covered with asphalt, which prevents the concrete from drying out; a rough calculation of the resistance of rails on the concrete foundation, toward the earth, assuming the highest value for concrete, gives values below 1 ohm for a length of 1 kilowatt. Experiments were also made with asphalt, but they were unsatisfactory as it was impossible to determine the difference between the conductivity of the material and the surface conductivity; it was found that the material does not take up any water and it is therefore thought quite likely that the rails may be well insulated from the earth if placed in asphalt and that this might prevent the earth-return currents. (It is quite unlikely however that any municipal authorities would allow the rails to be insulated, as they would then become a source of great danger for horses and pedestrians.)

Rouen. Lond. *Elec. Eng.*, March 20.—An illustrated description of the railway in that city.

The Future of Elevated Railroads. KLAPP. *Eng. Mag.*, April.—A short article showing the advantages of light cars run at frequent intervals as distinguished from heavy trains. He believes it is questionable if any more elevated railroads will be built in the United States. He makes a comparison of the train crew wages for operating a four-car train every six minutes as compared with three two-car trains every two minutes, assuming both to be operated by electricity, with but one man on the motor; the weight of the former train would be 87 tons, and of the three latter 48; he shows that the cost of labor compels managers who have heavy cars to bunch them into large units as the labor bills for the same carrying capacity are $8.10 and $12.15 respectively; owing to the different weights the saving in fuel and power-house equipment will be almost half, in favor of the light cars, but even if this does not counterbalance the extra labor bill, which in many cases it will, there is always a saving in the interest on the cost of the cheaper and lighter structure, besides the increased earnings due to better service; the average speed may also be raised on the lighter roads. He gives a detailed table of the comparative costs of the construction per mile of road for the light and the standard road, assuming that the stations will be much closer together on the lighter road and will be cheaper to build and operate; he gives a table of the comparative expenses per day for carrying the same number of passengers, assuming electric power, the figures being compiled from the actual expenses of one of the standard roads altered only by the substitution of estimates of those items which are affected by the substitution of electricity, and the reduction of station expenses made possible thereby; of a total saving of $898 per day, only $221 is effected in the operating expenses, the balance being due to saving in interest charges. He concludes that the future of elevated roads cannot lie in the beaten track of the present practice, but most cities of the second or third rank he thinks could support one or more elevated roads constructed on the lines suggested.

Automobile Vehicles. SALOM. *Jour. Frank. Inst.*, April.—A reprint of a lecture describing the "Electrobat," a carriage driven by accumulators which was described in the electrical journals some time ago.

New Orleans. Elec. Eng., April 1.—An illustrated description of some length of the electrical equipment of the railway in that city.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

High-Voltage Lamps and Their Influence on Central-Station Practice. ADDENBROOKE. Lond. *Elec. Eng.*, March 20; the conclusion of his paper (see *Digest* last week); the complete paper is reprinted in the Lond. *Elec.*, March 20, and is continued in the Lond. *Elec. Rev.*, March 20.—He discusses the possibilities of the use of accumulators in central stations in the future, with special reference to those using high-voltage lamps. Considerable changes have taken place in accumulators during the past two or three years; the maximum or safe discharge rate has been increased while the initial cost and the cost of maintenance have been decreasing; extended experience holds out the hope of much longer life for the newer forms of positive plates; patents are also expiring and considerable competition is arising in this trade. From quotations of leading makers of batteries suitable for central stations, he finds that the capital cost to discharge at one kw for three hours is $65 for the battery alone, or with connections, instruments, constants, buildings, etc., $95; they guarantee keeping the batteries in a state equal to new for about 6 per cent. per year on the capital cost. He thinks this raises questions of very serious importance in central-station practice, particularly in connection with higher voltage lamps; if an accumulator can discharge in three hours, a kw-capacity of accumulators will be equal to a kw-capacity in engines and dynamos; if a plant is to be increased the question arises whether the direct-generating machinery or the accumulators are better; he believes it will be generally accepted that the cost of engines, boilers, dynamos, steam pipes, buildings, accessories, etc., will cost about the same, namely, $95 per kw; if the foundations, flues, chimney stocks and everything else is considered, it would be slightly in favor of the accumulators; the cost of maintenance of 6 per cent. is not greatly in excess of what would have to be allowed for the plant if the boilers are included; the energy could be produced at an extremely low cost if the load is steady night and day; he thinks about ⅓ of the maximum full-load capacity would be about right at the present time for the accumulator plant; with a load factor of 10 to 15, and if the price of accumulators comes down, which he thinks is likely, it might be desirable to install accumulators for as much as two thirds or even three fourths of the full load, and this would place electric distribution nearly on a par with gas distribution in respect to the storage. At present the plates and lead cells alone would weigh about 8 cwt. per kw, on a three-hours discharge, making the cost about $200 per ton; as lead costs less than $60 per ton, and as the plates consist mostly of lead, it is not unreasonable to expect a considerable reduction in the price, say, down to $125 per ton, with, perhaps, improved capacity and life; he thinks there is good reason to expect improvements in this direction; he points out the improvements of the last five years and states that the arguments in their favor are much stronger now than they were formerly. On a three-hour discharge basis a kw-hour requires a space of 1.33 cb. ft.; comparing this with the amount of space of a gas meter to store gas for the same amount of light, he finds the latter would occupy 70 times as much space, or making all allowances, say, 10 times as much. It is usual to place the accumulators at the central station, which subjects it to the heavy drop at full load, this in turn decreasing the deficiency; with 220-volt lamps the drop on the feeders would be much less and therefore the value of the accumulators would be increased; for longer distances than a mile the right place for accumulators in most cases would be at the feeder points; if the capacity when placed there is one third to half of the full output, the feeder can be cut down by one third or a half, thus effecting a very important saving; all that is needed is a continuous-current motor-transformer of the booster type in which one armature circuit is across the mains and wound with a high resistance, while the accumulator current passes through the second circuit which is wound with a few turns, raising the voltage of the current through it by about 30 per cent.; the motor transformer need be only about one third of the capacity for the larger currents, and the cells can be charged at any time; by this means the cost of long feeders would be reduced, which means that it would be practical to extend the lighting radius much further; having once laid a feeder, accumulators can be added at the outer end as the lighting grows; with 220-volt lamps the cutting out of one accumulator makes much less relative difference, which is a point of considerable importance. The use of 220-volt mains will also do away with the necessity of having special power mains, as the drop in the line is less; the current from the outside mains, at 440 volts, could then also be used for tramway work, thus giving a day-load to the lighting stations; charging the accumulators during the night and supplying the railways during the daytime ought to secure a fairly even all-day load in one plant. In his general summary at the conclusion of his paper he expresses the belief that the use of 220-volt lamps makes the alternating-current system unnecessary except for special cases, and he thinks that, in view of these future developments, an alternating-current station should not be erected except after the most careful weighing of all the possibilities.

The Lond. *Elec. Eng.* contains the discussion in abstract, in which most of the speakers comment favorably on high-voltage lamps, but otherwise it contains nothing of special interest.

Accumulators in Central Stations.—See above, under "High-Voltage Lamps, Etc."

Operation of the Lighting and Power Station at Hamburgh. MEYER. *Elek. Zeit.*, March 12.—A short article containing a number of tables of data for nine months of the past year for this station; the station is of special interest as it was the first in Europe which was a combination of an electric lighting station and a power house for railways; the results showing the operation of the station are therefore of special interest; they do not admit of being abstracted.

Central-Station Statistics in Germany. Lond. *Elec.*, March 20.—A reprint of some of the tables which were abstracted in the *Digest*, March 28.

Development of Electric Power Stations. FIELD. *Cassier's Mag.*, March.—An illustrated article of some length pointing out the growth and development during the past few years, which he believes has been startling, not only in the electrical but in the steam machinery. The high-speed or automatic engine now gives satisfactory economy with a single valve up to about 300 hp; Corliss engines have been built for a higher speed, so that they can be directly connected; an intermediate field has been developed with a marine type of vertical engine; all these engines are coupled directly to the generators; in large stations one of the well-known types of water-tube boilers are universally used. Generators are now built for any capacity up to 5000 horse-power; many are of the iron-clad type; in the general type the fields are at the outside of the armature; for lighting, or direct-current work two generators are generally coupled to one engine; 150 to 200-light machines are now common in direct-current series arc lighting; the use of arc lights on the incandescent circuits is becoming more common; development has also been great in the methods of regulating and distributing the current from one station; feeder regulation has been done away with and boosters are being introduced; "storage batteries are beyond question to-day a commercial part of the central-station lighting business"; he believes in the centralization of the power plants at a point where water and coal are easily obtained, even though the feeders might cost more, the cost of generating power being reduced very largely; feeder distribution is generally introduced in large stations and is proving in every respect to be an ultimate gain; for low-tension currents the Edison underground tube system he believes is beyond question the best commercial practice. He discusses at some length the present condition for the commercial generation of power from central stations and the cost per kw; from one of the best power stations he finds that 4.25 to 5.5 pounds of coal are required from 9 a. m. to 9 p. m., and for the balance of the 24 hours from 5.5 to 9.75 lbs.; test records show that with an efficiency of 3 lbs. of coal per kw-hour, at a normal load, the station record would be about 4.25 per kw for a week's record. A number of load diagrams for central stations and one for a power house are given; for an incandescent station the records show that the generating capacity is not required to be more than 30 to 35 per cent. of the number of lamps connected exclusive of reserve; the average price at which power is furnished to large users for motor purposes is from 6 to 8 cts. per kw-hour and for lighting work the average charge is one cent per hour for a 16-cp lamp. In conclusion he gives some tables showing the cost per kw in railway central-station work in the best practice of to-day; from actual records of a triple condensing, direct-connected plant he finds that the cost is about 1.25 cents per kw-hour for manufacturing the current, 0.75 for distributing it, and 1.5 for general and executive expenses, making the total about 3.5 cents per kw-hour; the coal is approximately 40 per cent. of the cost of manufacture, labor is 50 per cent., the total manufacturing cost is 35 per cent. of the whole, while the distributing cost is 21 per cent. of the whole, and the general and executive expenses 44 per cent. of the whole; this is the best that he has found; the above refers to a large, modern lighting station; for railway work, compound engines and direct-connected units he finds that the average cost of power per car-mile is 1 cent, the cars being 18-foot, single-truck cars; the cost of manufacture of the current is about 0.9 cent per kw-hour, of which the coal is 63 per cent., labor 33 per cent., oil, waste and repairs, 4 per cent. He believes the time is coming when the cost of manufacture per kw-hour will be 1 cent for lighting stations and 0.75 per railway stations. A central-power station of, say, 5000 kw would cost as follows: Steam plant, $85 per kw; electrical plant, $30; building plant, $15 and sundries, $10, making a total of $140, exclusive of real estate.

Protection of Electrical Apparatus Against Lightning. WURTZ. *Cassier's Mag.*, March.—After a brief discussion of the general subject of lightning arresters, with special reference to his system of distributing the arresters at frequent intervals over the system, and of the important characteristic of static discharges, with reference to "selection," as distinguished from the "shortest path," he gives the replies received from a large number of prominent electric light and power plants regarding their experience with lightning arresters; he then discusses each of the different kinds of circuits, with reference to their protection against lightning; among his conclusions he states that for the protection of widely distributed apparatus, such as on lighting and street railway cir-

cuits, line arresters are being more extensively used, and, in his opinion, they form the only practical method of protecting this class of circuits; they are best distributed at frequent intervals over the system; in suburban districts four to the mile are recommended, while in city districts two may suffice; where banks of converters are concerned, four choking coils with four lightning arresters intervening are recommended; in railway power houses the tank arrester is considered an excellent protection to the generators; a choking coil and lightning arrester are usually placed on each car; for power transmission circuits on which the apparatus is at the extremities of the line, line arresters are not used, the generators, motors or transformers being protected by a proper installation of choking coils and lightning arresters at the points where protection is desired; he recommends short, straight connections to earth, good grounds and an occasional inspection of the arrester with reference to broken wires.

Protection Against Lightning. Wurtz. *Elec. Power*, March.—A short article giving somes notes collected during the past Summer; they are supplementary to those of the former year, which were noticed in the *Digest*, March 9, 1895. During the entire season 163 out of 272 arresters received discharges; no discharges entered the station at any time, and owing to the use of non-arcing arresters the service was not interrupted by the circuit-breakers; the largest number of arresters receiving discharges during any one storm was 63 and the smallest number 3; the discharges occurred regardless of elevation, woods, open country or ravines; the discharges occurred at one point or another, and not according to the shortest, easiest path, thus agreeing with his laboratory experiments; they are governed by circumstances over which one has no control, that is, by the electrical conditions which exist in the line at the time of discharge; these conditions are, that interfering electric waves produce points of high and low pressure, that the tendency to a side flash or discharge is enormously greater for the points of high pressure, and that these points of high and low pressure are constantly shifting their positions, making it impossible to predetermine their location; the conclusion, therefore, is that in order to make protection reasonably certain it is necessary to place a number of arresters along the line in order that some of them at least will in every case be found at the points of high pressure.

Riverhead, L. I. Benoliel. *Elec. Power*, March.—An illustrated description of this plant, located 73 miles from New York, for incandescent lighting. Though small, it is claimed to be of interest, as it is a combination of water and steam power plant, rather poorly designed, the head of the water varying according to the tides; it is doubtful whether the plant is a paying one.

WIRES, WIRING AND CONDUITS.

Laws Regarding the Use of Electricity in Mines, Quarries and Factories. Bul. l'Ass. Ing. El. Montefiore, Jan. 24 and March 12.—A reprint of some length of the laws presumably, of Belgium.

Wiring Rules. Lond. *Elec.*, March 20.—A reprint of the new rules of the St. Pancras station, from which the current will be supplied at 220 volts.

Wiring. Lond. *Elec. Rev.*, March 20.—A continuation of the communicated discussion, containing, however, little of interest from a technical standpoint.

Wiring. Jour. Inst. Elec. Eng., March.—A reprint of the complete discussion of the recent papers of Bathurst and Mavor.

High-Tension Cable Coupling. Lond. *Elec. Rev.*, March 20.—A brief, well-illustrated description of the Penson coupling; the end of the cable terminates in a sort of stuffing box, the ends of which are then joined with a screw coupling.

ELECTRO-PHYSICS AND MAGNETISM.

Roentgen Rays.—The Lond. *Elec.* and *Elec. Eng.*, March 20, contain a brief abstract of a Physical Society note, by Dr. Puluj; he made photographs with his special form of tube described in 1889 (see below); he succeeded in obtaining impressions with exposures of only two seconds; he thinks the particles of matter torn from the cathode and which convey the negative electrostatic charges, equalize their electric charges by impact on the glass walls or on seams, and in this process they call forth not merely a disturbance of the material molecules, but also of their ether envelopes; every portion of the glass acted upon becomes a starting point of ether waves which, according to their oscillation period and oscillation character, are either visible rays in the form of phosphorescence or invisible Roentgen rays; the latter may be longitudinal, but no convincing argument has so far been brought forward to support this view.—In another Physical Society note by Ackroyd and Knowles they describe experiments with medals, oxides and sulphites in order to determine whether their permeability depends on the atomic or molecular weight of the body; in every case they found that the opacity increased with the molecular weight. In the discussion Mr. Blakesley stated that he considered the Roentgen rays to be the propagation of electrostatic strain through space; a dark line at the edge of the shadow of a wooden pencil, he thinks, might have been due to the refraction of the rays by the wood; he found however that it was due to the varnish on the pencil; quartz and ebonite rods not only did not show these lines, but there was a slight indication of a bright line on the edge of the shadow, which would indicate that the refraction was less in the rods than in the surrounding medium. Mr. Edser showed photographs taken with Jackson's form of tube in which a convex cathode is used; the whole tube on the cathode side of the anode phosphoresced so that the rays seemed to partake of the character of diffused light. Prof. Ayrton found that the rays from that tube form a parallel beam and do not first come to a focus and then spread out. Mr. Blakesley described the Puluj tube, stating that there was a mica screen coated with green calcium sulphide placed between the cathode and the anode. Mr. Gardner stated that the phosphorescence on the inside of the glass had been shown by Lenard to be due to electricity traveling around the inside surface of the glass. Capt. Abney is said to have found that if the filament was mounted on a ferrotype plate no action took place. Prof. Perry is of the opinion that the rays are undulatory and that Prof. Larmor's explanations seem to agree with the facts; in this it is supposed that the intermolecular spaces respond to vibrations of a certain frequency; the reason why no refraction or diffraction effects have been observed is probably because of the extreme smallness of the wave-length.

The Lond. *Elec. Eng.*, March 20, states that Mr. Kent has succeeded in transmitting the rays through the body so that the most deeply seated viscera become visible, and the conditions of such organs as the kidneys can be investigated; photographs which have been taken so far show portions of the body below the fifth rib down to the pelvis; the space occupied by the kidneys is slightly more transparent in the negatives, thus indicating that the kidney itself is more opaque than the surrounding tissues. There is considerable difference in the relative transparency of different stones, or renal calculi, and they are sufficiently opaque to differentiate them from the surrounding tissues. Mr. Jackson found that the best fluorescing material to use is potassium platino-cyanide.

The Lond. *Elec.*, March 20, contains a brief abstract from the numerous articles from *Comptes Rendus*, which were abstracted in the *Digest* last week, among which is a rather longer abstract of a paper by Becquerel.

The Lond. *Elec. Rev.*, March 20, states that Dr. d'Arsonval used a Geissler tube placed in a glass tube filled with fluoresceine; the sensitive plate was wrapped in several thicknesses of black paper; good photographs were obtained and he concludes that fluorescent rays alone will produce Roentgen photographs. Mr. Bonella, in the same journal, states that he obtained good instantaneous negatives with a new form of tube, the exposure being only about half a second; no further information is given except an editorial statement that the photographs were remarkably clear.

The *Elek. Zeit.*, March 19, states that Betz places a Hittorf (Crookes) tube in a solenoid through which a strong current passed, the direction of the tube being perpendicular to the plane of the windings; when adjusted correctly the action of the solenoid is to condense the bundle of rays so that they will pass in greater numbers through the perforated plate used as a stop; it is said to increase the intensity of the action of the rays on a photographic plate.

Longitudinal Light. Jaumann. Lond. *Elec.*, March 20.—The conclusion of the translation of his long article (see *Digest*, last week); no summary or general conclusions are given.

Globular Discharge. Righi. *L'Eclairage Elec.*, March 14.—A continuation of a long serial.

Maxwell's Equation for Magnetic Tractive Force. Jones. Lond. *Elec.*, March 20.—An editorial abstract of the recent article in the *Phil. Mag.* (see *Digest*, March 21).

Theory of Oscillating Currents. Steinmetz. *Phys. Rev.*, March-April.—An article of a mathematical character, the object of which is to give a short outline sketch of a modification of the method of complex imaginary quantities, applied to oscillating currents; such currents have frequently been considered as ordinary alternating currents of high frequency, the essential conditions, however, having been overlooked; they are alternating currents if the arithematic mean value equals zero and pulsating currents if this value differs from zero, the time intervals being equal; oscillating currents are currents of constant period and geometrically varying amplitudes, the amplitude of each following wave bearing a constant ratio to that of the preceding wave; the wave-lengths are constant but the waves decrease in amplitude that is, in current strength, in constant proportion. He discusses the relations mathematically and draws conclusions from them; one of these is that in an oscillating-current circuit the counter E. M. F. of self-induction is not in quadrature behind the current, but lags less than 90 degrees, and the charging current of a condenser is less than 90 degrees ahead of the impressed E. M. F.; in consequence of the existence of negative energy components of reactance, a phenomenon can exist which has no analogy in alternating-current circuits, which is, that the total impedance of the oscillating-current circuit can equal zero; the conditions for this are given; from this it follows that such a current when once started will continue without external energy impressed on the circuit; the physical meaning of this is that if a certain amount of energy is impressed on a circuit which is then left to itself, the current will become oscillating with a certain frequency and decrement; this shows the origin of the oscillating current, and the means to produce them; the most important oscillating currents are those flowing in a circuit of zero impedance; lightning strokes usually belong to this class;

some numerical examples are given (see THE ELECTRICAL WORLD, last week, page 360); the mathematical relations in the oscillating-current transformers are given.

Induction Phenomena in Alternating-Current Circuits. MILLIS. *Phys. Rev.*, March-April.—In the discussion of the current curve produced on closing a circuit containing a harmonic E. M. F. resistance and self-induction writers have generally neglected the exponential term in the equation; neglecting this term is equivalent to assuming that the current at once reaches its permanent condition; the present article deals with the curves as modified by this term, and is of an experimental nature.

Roentgen Rays. HOUSTON AND KENNELLY. *Frank. Inst. Jour.*, April.—A reprint of a lecture and a long discussion at a meeting of that institute held Feb. 19.

The *Elec. Rev.* and *Elec Eng.*, April 1, contain a list of the substances which Mr. Edison has found to fluoresce with X-rays, also of some of those which did not.

On Electrical Discharges Through Poor Vacua, and on Coronoidal Discharges. PUPIN. *Elec. Age*, March 28.—The beginning of a reprint of a paper read before the National Academy of Sciences, April 22, 1892.

Photographic Study of Arc Spectra. BALDWIN. *Phys. Rev.*, March-April.—The first half of an article giving experimental results.

Demagnetization Factors for Cylindrical Rods. MANN. *Phys. Rev.*, March-April.—An investigation to determine whether in the formula for ellipsoids the constant, depending on the ratio of the axes, is as independent of the field strength and intensity of magnetization for cylinders as for ellipsoids, and whether or not its value is the same for a cylinder as for the corresponding ellipsoid; the original formula applies either to rings or ellipsoids, the use of either of which is open to practical objections; cylinders, however, are easily procured, and the determination of the susceptibility would be greatly facilitated if they could be used. He made a long series of tests with cylinders of different forms and deduces the conclusions, which are, that the mean magnetization of the cylinder does not differ greatly in amount from that of the corresponding ellipsoid for intensities of magnetization less than 800 C.G.S. units; for values greater than 800 an ellipsoid assumes a much stronger magnetization; wire bundles, when the intensity is less than 800, assume a much stronger magnetization for the same magnetizing force, than either the corresponding ellipsoids or cylinders, but the ellipsoid has a greater susceptibility for higher values; cylinders whose length is 20 to 30 times their diameter differ mostly from the corresponding ellipsoids in their reaction toward induced magnetization. His results are of practical value as they enable one to determine the susceptibility from observations made by the ordinary magnetometric method on cylinders.

Principles of the Magnetic Field. BEDELL. *Elec. Power*, March.—The beginning of an article of an elementary character introductory to the subject.

ELECTRO-CHEMISTRY AND BATTERIES.

Carbon Ions. COEHEN. *Elek. Zeit.*, March 19.—A reprint of a short paper describing experiments with a battery in which carbon is consumed. The problem of the direct production of electricity from carbon would be solved in the most simple way if one could dissolve carbon in a liquid, like other metals; or, in other words, if it is possible to form ions of carbon; he refers to a former paper by Bartoli and Papasogli (*Beibl. zu Wied. Ann.*, Vol. 8, pp. 132 and 653, 1884) in which they state that in the electrolysis of dilute solution of sulphuric acid between carbon electrodes part of the carbon enters into the electrolytic action in such a way that there is formed carbon dioxide, carbon monoxide and oxygen. The present writer made researches in which the concentration, temperature and current density were so varied that no oxygen was produced at the anode, the only products there formed being those due to the combination of the carbon; he did not succeed in getting carbon dioxide or carbon monoxide alone, but obtained a mixture which contained about 1 per cent. of oxygen; it was formed of about 70 per cent. of carbon dioxide and 30 per cent. of carbon monoxide. He found that at low temperatures there was a disaggregation of the carbon anode and that suspended particles of carbon was seen in the acid, but at higher temperatures this did not take place, but there was a distinct coloring of the acid, which was at first yellow, then a dark red and a reddish brown; if this was a solution of carbon due to the current, then the carbon was presumably in the form of ions, and if so, the carbon should be redeposited on the cathode; if therefore the cathode was made of platinum, carbon should be deposited on it like a metal; which was found to be the case; at first it was brightly colored, and then as the deposit became thicker it had a graphitic black appearance; various kinds of carbon anodes gave the same result; especially good were ground coal and homogeneous arc-light carbons; with coke the experiment was also successful. A number of tests were made to prove that the deposits were carbon, and not a metal which may have been contained as an impurity; the deposits were not attacked by hydrochloric acid and only slightly by boiling nitric acid; in the flame even thick deposits disappeared quickly and entirely; it was also tested in the same way in which carbon in iron is measured; besides these a number of other analyses were carried out; it was found that besides the carbon there was either a conducting hydrate of carbon in the deposit, or else the deposit contained a sort of water of crystallization. He then tried to make a battery on this principle; the other plate was made of peroxide of lead like a positive plate in the ordinary accumulator; under the particular conditions regarding concentration, temperature, etc., which he found, (and which are not stated in the paper) he obtained a cell in which the carbon anode was dissolved, and which gave a strong constant current; when the external resistance was 100 ohms, the voltage was 1.03. The question arises, what part if any, in the development of the current, is due to the carbon; a platinum plate in place of the carbon gives a current in the same direction, but it polarizes; if the carbon only acted as an insoluble anode, the current would cease like with platinum, but this is not the case, as the current continues until the peroxide plate has been discharged, and when this is renewed the current continues again. The question arises what valency has the carbon in this form; he was not ready to answer this yet, as he never obtained the carbon alone, like copper from a copper sulphate solution, but always obtained hydrogen with it; an attempt to calculate the valency from the anode was even more difficult, as there were three actions taking place together, the formation of the two carbon products and the formation of the solution.

In an editorial discussion in the issue of March 12 the paper is spoken of favorably, but it is not thought possible yet to say whether this cell can be practically applied in the solution of the problem, or the direct conversion of the energy of coal into that of electricity; it is necessary to find what part of the electrical energy produced has a chemical source, and how much of it is obtained from the heat of the surrounding air; it should also be noticed that the cathode is a rather expensive material; if it were possible to replace the lead peroxide with an oxide found in nature, as, for instance, that of iron, the reduction of which would form a valuable bi-product, the value of the process would be much greater; it would then be a process like that in furnaces, in which metallic oxides are reduced by carbon, and in which the energy of the oxidation of the carbons is given off as electric energy. It is thought that Coehen was the first to determine the exact conditions under which the carbon is dissolved without the formation of oxygen; it is a question whether the carbon itself passes into solution, or whether it is a combination which could produce the final product; it is thought that the process will be of great value in organic chemistry. (The original article contains very little more than what is given in the above abstract.)

Electrical Energy Direct from Coal.—See abstract above on "Carbon Ions."

Charging Accumulators at a Constant Power. SIMON. *L'Elec.*, March 21—Charging accumulators with a constant current has the objection that it takes long, that the current is not as strong as it might be in the beginning and too strong at the end; in charging at a constant potential, the charge is quite great at first, perhaps even too great, and toward the end is so small that it prolongs the time of charging; in two or three hours the battery receives more than three quarters of its capacity and one is then tempted to stop the charge; such a method of charging is not well adapted to the use of dynamos. To overcome the objections to these two systems he suggests a third method, which is not well known and consists in charging a battery at a constant power, that is, with a diminishing current and increasing voltage, the rates of which are such that the product is always constant; he claims that this is the least injurious method of charging and almost always the most economical. (With good, low resistance and rapid rate accumulators, this method will differ but little from the constant-current method.)

Removing Tin from Tinplate Scrap. KOTZUR. Lond. *Elec.*, March 20.—A brief extract from his recent German patent; he proposes to use caustic alkali as the electrolyte, the anode being the scrap to be stripped; the inevitable deterioration of the electrolyte is provided for as follows: When the voltage becomes unremuneratively high a part of the electrolyte is removed and replaced by fresh caustic soda; the saturated material is freed from tin by treatment with carbon dioxide; the precipitate is pure and can readily be reduced to metallic tin, while the sodium carbonate is converted into caustic soda again.

Evolution of the Storage Battery. BARNETT. *Jour. Frank. Inst.*, April.—A reprint of a recent paper; it is mainly historical in character, touching somewhat on the theory of the accumulator; the latter subject is discussed at some length by Mr. Reed, who does not agree with the author.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measurement of Watts in Three-Phase Circuits. BEHN-ESCHENBERG. *Elek. Zeit.*, March 19.—When there is no middle wire, and when the load on the three branches is unequal, the measurement of the watts in three-phase circuits involves difficulties; in the present short article he suggests a method which, with the usual wattmeters, is easily applied. The resistance of the shunt coil should be small as compared with that of the inductionless resistance in circuit with it; he uses two such resistances, which are equal to each other, one end of the one being connected to one of the three leads and one end of the other to one of the other leads, the other two ends of these resistances being connected together and to the end of the shunt-coil of the wattmeter, the other end of which is connected to the third wire of the three-wire system; the series-coil is placed

in this third circuit. The theory of this connection, he says, is easily deduced; through the shunt-coil passes the sum of the two currents through the resistances, each of which is proportional to and in the same phase with the voltage between the main current in the wattmeter and each of the other two circuits; the deflection of the wattmeter will therefore give directly the total energy of the three-phase currents, even when the three branches are unequally loaded. In this method the sum of the actions of two shunt-coils or of two successive measurements, each with a shunt-current, is replaced by taking the sum of the two shunt-currents in one single coil.

Method of Measuring Coefficients of Induction. Andreissen. *Elek. Zeit.*, March 12 and 19.—A long, illustrated article, explaining in some detail how the method of Graetz is carried out, including a description of the apparatus; the apparatus includes a Wheatstone bridge, a telephone, a source of intermittent current and variable induction-coils.

Wheatstone Bridge for Determining Low Resistances. Reeves. Lond. *Elec.* and *Elec. Eng.*, March 20; a reprint in abstract of a Physical Society paper.—The arrangement described can be used for measuring the resistance of meter lengths of wires of low resistance; the apparatus consists of an ordinary resistance box, a meter bridge and a sensitive galvanometer; it differs from the ordinary Kelvin bridge "in that instead of balancing by varying the length of the standard wire between the contacts, the distance between these contacts is maintained constant as is also the length of the wire which is being measured, a balance is obtained by altering other resistances in the network"; no further information is given; with this arrangement the resistance of copper wires one metre long between No. 22 and a stranded cable of seven No. 16 wires, can be measured with an accuracy of 1 per cent. In the discussion Prof. Ayrton stated that the advantage of the method lay in the fact that it was independent of the resistance at the contacts; in the Carey-Foster method errors might be introduced owing to the resistance of the mercury contacts, which unless cleaned every day and re-amalgamated would become variable. Prof. Foster showed how, with his method, the accuracy of the result depends not on the elimination of the small resistances at the mercury cups, but on the constancy of this resistance. Mr. Appleyard thinks better results would be obtained with a galvanometer of one or two ohms resistance.

Sullivan Galvanometer. Lond. *Elec.*, March 20.—Some very favorable comments by Mr. Keith and Mr. Raymond-Barker, giving their experiences with this instrument on board cable ships; the former states that it is practically unaffected by the ship's movements, is very sensitive, beautifully deadbeat and enables accurate tests to be made rapidly; he considers it far superior to the ordinary marine galvanometer. The latter states that the good opinion he had of it has been confirmed; it is a good time-saver as it enables all observations to be made far more rapidly than is possible with the old form of instruments, thus shortening the time during which the ship had to hang on to the cable; the zero point is also quite constant.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Statistics for Austria. Zeit. f. Elek., March 15.—Tabulated statistics of the urban and interurban lines.

Twenty Years' Progress in Telephony. McMynn. *El'ty*, April 1.—A reprint of a rather long abstract of a paper read before the Chicago Electric Association.

MISCELLANEOUS.

L'Eclairage Elec.—From the first issue of January to that of March 7 inclusive this journal was not received, and was, therefore, not abstracted. The regular abstracts will begin again with the issue of that journal of March 14.

Abstracts. The *Jour. Inst. Elec. Eng.*, March, contains a number of abstracts from Continental papers, which are rather longer than those which have appeared in the *Digest*.

Introducing Drugs into the Body. West. Elec., March 28.—A brief description of an experiment. If a drug, such as morphia, is to be introduced say on one side of the head, the negative electrode is placed at the foot on the opposite side, together with a wet sponge and a layer of starch, the positive electrode containing the morphia being placed at the head; within 60 seconds the same change is usually produced in the starch under the foot as would be produced by the direct contact with iodine.

New Books.

Electric Wiring. For the use of architects, underwriters and the owners of buildings. By Russell Robb. New York: Macmillan & Co. 183 pages, 76 illustrations. Price $2.50.

The special audience to whom this book is addressed—architects, underwriters and the owners of buildings—are fortunate in having within their reach a work so admirably adapted to their needs as the present one. The small amount of electrical knowledge necessary for the understanding of the subjects treated is presented in such clear and simple language and logical sequence as to render it easily grasped at the first reading, and this without descending into kindergarten methods of exposition, which, to the intelligent classes for whom the book is written, would probably be far from acceptable.

The first two chapters are devoted to explaining elementary principles, including also the subject of the heating of wires and the proportioning of conductors. The following chapters are on systems of distribution and methods of wiring, the latter subject being treated in a general way, no attempt being made to teach the trade of wireman.

The final chapter, which comprises more than two thirds of the entire volume, deals entirely with wiring rules, and is a model of its kind in every respect. The code of the Underwriters' National Electric Association, as printed and endorsed by the National Board of Underwriters, has been accepted as the text upon which to base explanations, for the reason, it is stated, that it is now the standard code throughout the country and accepted by electrical engineers in general as the best existing guide for safe construction. The rules are taken up in the order in which they are arranged in the code, section by section; following each section (reprinted verbatim) are explanations of the various electrical terms used in that section, with one or more illustrations, where necessary to make the meaning clear, together with the reason that makes the rule necessary, and instructions as to how its requirements may be met. As an example of the method of treatment, we select at random the section of the code on "future work." After quoting the rules verbatim, an "insulating joint" is illustrated and described, an illustration given showing the danger from its absence, followed by another illustration of a fixture supplied with a joint and lettered to make clear an accompanying explanation of its component parts—the shell, supply conductors, fixture wires, casing, splices, etc. In addition, all of the various references in the code are taken up and explained with reference to their bearing, such as "burrs and fins," "sealing," "ceiling block," "bushings," etc. Some of the sections have even more illustrations than the above, as, for instance, that on outside conductors, in which a "tie-wire," "guard-iron," "cross-arms," "petticoat insulator," "rubber-hook insulator," "twisted joint" and "service-block" are represented by engravings, as are also two examples showing how dangerous cross-connections may be formed.

Though written primarily for the classes named in the title this excellent manual will be of value to both wiremen and others engaged in electrical work, if for no other reason than to make them thoroughly informed of the exact bearing of every one of the hundreds of rules in a code that otherwise few would take the trouble of studying in detail—its pages offering to the reader an interest that would tempt him to a knowledge that otherwise could only be obtained by a study of a dry code that few ever attempt except with respect to such of its provisions as, from time to time, come up in the course of work.

Elementary Treatise on Electricity and Magnetism. Founded on Joubert's "Traite Elémentaire D'Electricité." By G. C. Foster, F. R. S., and E. Atkinson, Ph. D. London, New York and Bombay: Longmans, Green & Co. 552 pages, 380 illustrations. Price, $2.25.

In a biographical sketch of Prof. Jules François Joubert, Prof. Andre Blondel, the eminent French savant, refers to the original of this work in the following terms: "Recently Prof. Joubert has written an elementary treatise on electricity which is a model of its class in clearness and exact statement, and promises to become a classic like the great treatise of which it is an abridgment [Mascart & Joubert's "Lecons sur l'Electricité"]." The idea of Profs. Foster and Atkinson, we learn from the preface, was originally to simply translate the French work, but on further consideration it was decided, while adhering to the general plan and scope of the original, to endeavor to introduce into it the nature of electrical phenomena which was originated by Faraday and developed by Maxwell.

In its final form the work is somewhat more academic that is customary with most electrical treatises, in this respect bearing a considerable resemblance to the English edition of "Ganot's Physics," of which one of the present authors is a translator. The apparatus illustrated is mostly of the time-honored classroom type, and the text is severely academic, having few allusions to the practical sides of the subjects treated. The treatise, nevertheless, is a valuable one for teaching the essential principles of electrical science, though, owing to the lack of perspective, which its method involves, it is better fitted for class-room use than for independent study. The mathematics is simple, not extending beyond the elementary calculus. For a high school electrical course or a general electrical course in the scientific department of a college, or as the first book in an electrical engineering course, the book is as well, and perhaps better, adapted than any other work of its kind.

Electricity for Everybody. Its nature and its uses explained. By Philip Atkinson, A. M., Ph. D. New York: The Century Company. 239 pages, 100 illustrations. Price, $1.50.

The object of this book, as stated in the preface, is to meet the public demand for information in regard to the nature and uses of electricity, and the various kinds of apparatus by which it is generated and employed. If we restrict the word public so as to include the intelligent, general reader, but not those unaccustomed to the academic method of treatment, or who are connected with the electrical industry, the work may be said to fulfill its purpose. To the educated man and to the reader accustomed to books that imply the exercise of the thinking powers in perusing

their pages this book will prove satisfactory, for it is clearly written, logical in its arrangement and its development of subjects, and what is usually not characteristic of popular books, it is scientifically accurate. To the unthinking class, however, who must have their mental pabulum prepared and served with the same care that the infant is nourished, its "meatiness" will prove somewhat of a deterrent; and to the electrician most of its information is of too elementary a character. Some parts of the book, however, will be of interest and value even to the latter, particularly the introduction on the nature of electricity and the very full section on static electricity, in which lightning and the aurora borealis, among other subjects, are most satisfactorily treated.

Those who wish to satisfy the desire of an educated friend, who wishes to know something about electricity, cannot do better than present to him a copy of this handsome book—with the caution, however, that the view there given is from the academic standpoint, as distinguished from the matter-of-fact view of those engaged in electrical pursuits.

THEORIE DE L'ELECTRICITE. Exposé des Phenoméne Electriques et Magnetiques, Fondé Uniquement sur l'Experience et le Raisonnement. Par A. VASCHY. Paris: Baudry et Cie. 334 pages, 74 illustrations. Price, 20 francs.

The introduction states that the object of the work is to present a treatise on magnetic and electrical phenomena founded solely on experiment and reason, and divested entirely of the various hypotheses which heretofore have had place in similar works. The author states that there is no reason for attributing to electrical and magnetic forces properties different from those of other forces. They are measured exactly the same, whether by the acceleration they impart to a body of known mass (method of oscillation), or by the amount and direction of other forces susceptible of establishing their equilibrium (static method). He therefore puts aside all theories of electrical fluids, electrical masses acting at a distance, etc., and confines himself to the experimental notions alone, and to their mathematical interpretation by the ordinary mathematical methods applied to other forces.

While less extensive than the author's prior work, "Traite d' Electricite et du Magnetisme," the present volume is none the less difficult for other than students and readers well advanced in mathematics.

ELECTRICITY UP TO DATE. Light, Power and Traction. Fifth edition. By John B. Verity. London: Frederick Warne & Co. 238 pages, illustrated. Price, $1.

Written for a popular audience, and particularly for those wishing to know something of the "mysterious agent" which illuminates their houses, this little book has apparently served a useful end, for we learn from the preface that more than 20,000 copies of it have been sold. For such readers it is much superior to most of the popular writings on the market dealing with electricity, and the writer is to be congratulated upon his success in having produced a book which is made interesting to the lay reader without, as is usually the case with popular books, resort to exaggerations and sacrifice of truth to flashy hyperbole and unwarranted speculation. A chapter on "The Public Supply Companies" will be found of interest by other than the lay reader, as in it is given detailed information of the various electric lighting companies of London and the provincial towns of Great Britain, including capitalization, current selling price of stocks and bonds, dividends paid, number of lamps connected, selling price for current, etc.

SHOP KINKS AND MACHINE SHOP CHAT. A series of over 500 practical paragraphs in familiar language, showing special ways of doing work better, more cheaply and more rapidly than usual. By Robert Grimshaw, M. E. New York: Norman M. Henley. 393 pages, 222 illustrations. Price, $2.50.

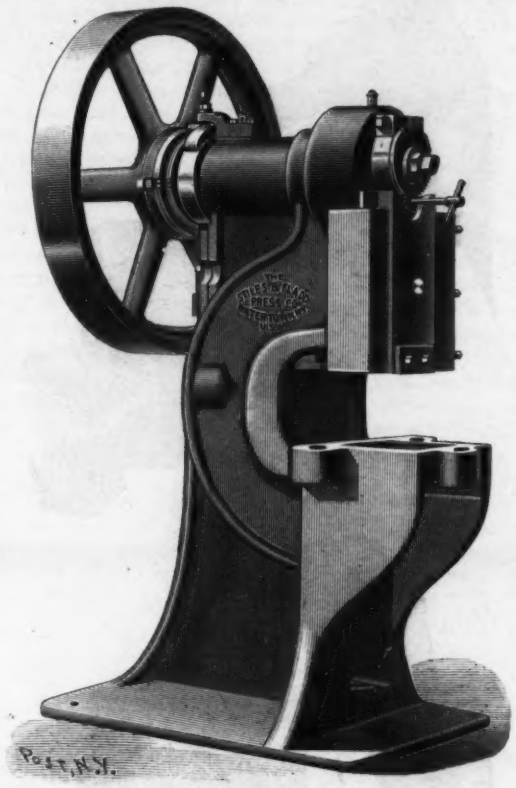
The title describes the character of this useful book so clearly that little can be added in that respect. From the preface we learn that the material contained is transcribed from note-books, covering a period of about 30 years, and including the result of observations in the important industrial establishments of the United States and Europe. The illustrations—222 in number—are without an exception that we could discern specially prepared to illustrate the points treated, and this they do in such an admirably clear manner that in many cases recourse to the text for further information is not necessary. To the intelligent mechanic this book will prove of probably more value than any other shop help published.

Improved Punching Press.

In the accompanying cut we illustrate a new punching press, made by the Styles & Fladd Press Company, Watertown, N. Y., which, while it follows in a general way the well-known Stiles press, still embodies such improvements as the trade demands and the knowledge of such demands warrants.

The company makes a special claim for excellence of workmanship and the selection of each separate kind of material of which the press is constructed. A special mixture of iron is used in their castings, such a mixture showing the greatest strength, which is continually tested and retained to an established standard. Every part on which the slightest wear occurs is carefully scraped to an exact fit, thereby providing a perfect bearing surface.

The ways or guides of the slide are exceptionally long, which resists absolutely any side thrust. The clutch adopted by this company is one that has been perfected and recently patented, and is superior in many ways to the Stiles clutch and Stiles press. Among the special features are the ability to run the press in either direction equally well, three points of contact in the wheel causing the clutch to be practically instantaneous, and the power vested in the operator to make, at will, a whole revolution or only a part as he may desire, thereby preventing accidents



PUNCHING PRESS.

both of tools and operators. The clutch can be used to back out a punch that may become stuck in the die.

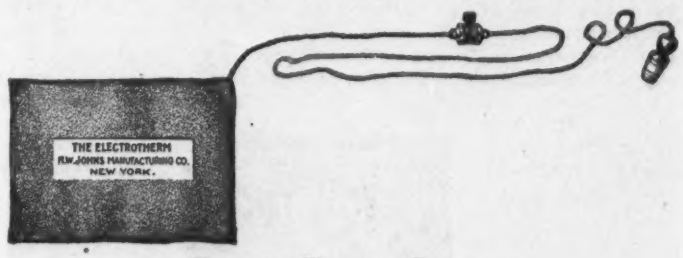
These presses are manufactured in six sizes, weighing from 500 to 7500 pounds as fly presses, and in five sizes, ranging in weight from 1200 pounds to 8000 pounds as geared presses.

The patterns are so constructed that an endless variety of modifications and changes can be made to adapt them to special work and tools of any make.

Electrotherm.

This device represents one of the latest applications of electric current for useful purposes, and consists of a flexible sheet or pad of asbestos with embedded wire, which, when connected to an ordinary incandescent lamp socket, produces a constant and uniform degree of heat.

The electrotherm, which is made by the H. W. Johns Manufacturing Company, of New York, is used by many prominent physicians and hospitals in New York, and is warmly endorsed. It is useful and convenient



ELECTRIC HEATING DEVICE.

for therapeutic practice in localizing and preserving uniform temperatures, and as such has a very wide application.

A switch gives three degrees of heat—130, 170 and 220 degrees Fahr., and in addition to its use by physicians it forms a convenience in the household.

The electrotherm is made for any voltage from 5 to 125, and can be used with either direct or alternating-current. The standard size of the device is 11 x 15 inches, and ¼ inch thick, and with 15 feet of conducting cord, a plug and a regulating switch the outfit is complete.

Eclipse Electric Lamp.

The popular demand for a reliable portable electric lamp seems to have been met in the Eclipse Electric Lamp, of which illustrations are given herewith.

What is needed in this line is a lamp that is small, light in weight, simple in construction, easy to operate and not liable to get out of order with ordinary use. To produce such a lamp was the object of several years' labor and costly experimental work, and the result is now offered to the public by the Eclipse Electric Lamp Company, of Buffalo, N. Y.

Charging Lamp.

Removing Zinc.

The Eclipse lamps are designed as bicycle, carriage and wagon lights, and for any other purpose where a portable light is required. They can be operated by a child as easily as by a grown person, and the light cannot be jolted out or blown out. The light, it is stated, is projected from the lamp for 75 or 100 feet and is alway strong while in use.

The case contains a primary battery, which generates the current for the incandescence of the lamp. The battery is very easily recharged, and at a surprisingly small cost. Charges of Eclipse Electric Sand are supplied in small tin boxes and the operation of pouring the contents into the battery is a very simple matter. The lamps as a rule will burn through an entire season, while new ones can be had at a low cost. The lamps are especially made for this battery.

Bicycle Lamp.

Two sizes of Eclipse lamps are manufactured—No. 2 and No. 3. The No. 2 lamp is intended for bicycle use, and is 3½ inches in width, 3 inches deep, 4 inches high and weighs 16 ounces. The No. 3 lamp is designed for carriages, wagons, miners, watchmen and for general portable use. It is 4¼ inches wide, 3½ deep, 5 inches high and weighs 26 ounces.

"Pioneer" Enclosed Arc Lamps.

The accompanying illustrations show a "Pioneer" ornamental lamp and the enclosing bulb, gas-check plug and lower carbon holder. This lamp is the one that was brought to public notice in a paper read by L. B. Marks at the International Electric Congress in Chicago, 1893, its essential feature being the enclosing of the arc in a globe. Mr. Marks has since then improved the lamp, so that it now holds an established reputation in the field of electric illumination, and has proved itself efficient and economical in operation directly across an incandescent circuit.

Pioneer Ornamental Lamp.

The mechanism of these lamps is simple, consisting of a pair of solenoid magnets bearing the clutch device—tension springs, rack-work and auxiliary mechanism being entirely done away with.

The principal features of the "Pioneer" lamps are that they require trimming at intervals of only ten days or two weeks, while in some situations, with short hours of burning, a monthly trimming is sufficient; the lamp does not require cored carbons, the ordinary solid carbons being used. This results not only in a saving on the cost of carbons, but also in that of trimming.

Gas Check Plug Enclosing Bulb. Lower Carbon Holder.

Owing to the arc being enclosed, it is possible to run the lamp on incan-

descent circuits at a much higher potential than where the arc is not enclosed, so that it can be run singly, each lamp independent of the other. The distribution of light is so nearly perfect that this quality is shown by the absence of shadows of the carbon points on the globe, the higher voltage between the carbons permitting a longer arc and consequent emission of light rays through a wider angle.

The entire system is covered by broad patents, which are owned absolutely by the Electric Arc Light Company, 687 and 689 Broadway, New York. It is interesting to note in this connection that nearly 1000 of the "Pioneer" enclosed arc lamps will be installed in the great department store now being erected in New York by the Siegel-Cooper Company.

New Alternating-Current System.

The tendency to the increased used of the alternating current for the distribution of light and power over moderate-sized and large areas has directed the attention of many electrical engineers and manufacturing concerns to the improvement and development of apparatus of this class.

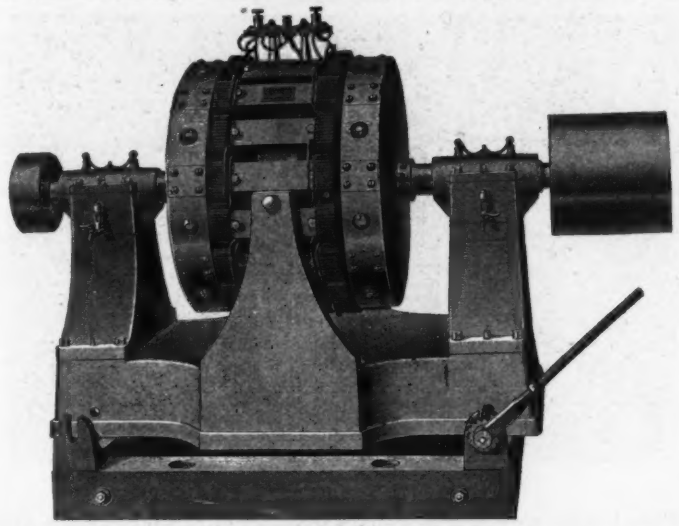


FIG. 1.

Fully appreciating the meaning of the "handwriting on the wall," the Royal Electric Company, of Peoria, Ill., while manufacturing both continuous and alternating-current machines, proposes to give greater attention to the development of its alternating-current system, for the reasons above given.

The company's alternator is constructed with four principal objects in

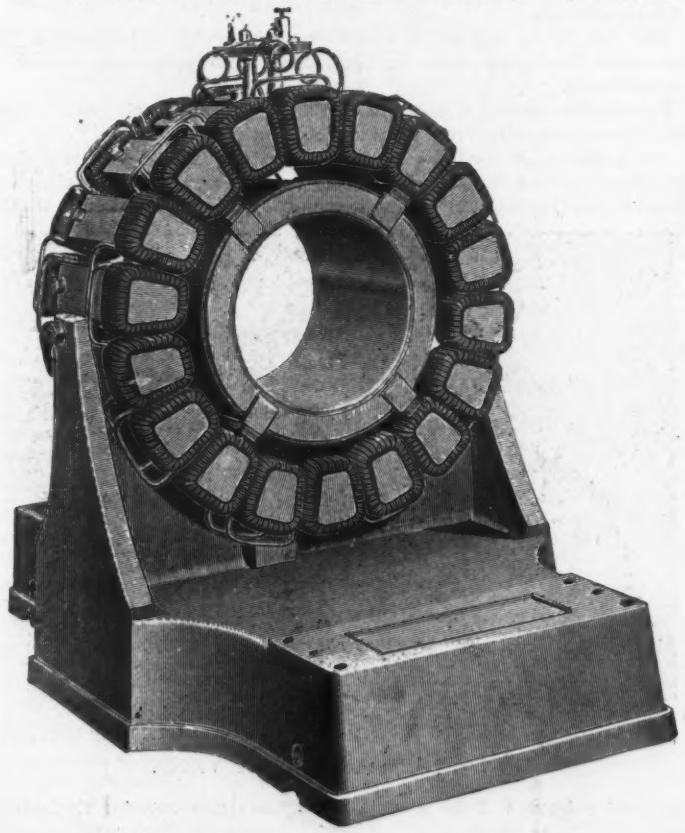


FIG. 2.

view, viz.: First, the prevention of trouble by utilizing a rotary magnet without moving wire; second, dispensing with high or low-tension collector rings and brushes; third, furnishing current for one circuit or for two independent circuits, and, fourth, so that it may be used either as a single-phase or two-phase machine. It is up-to-date in design and construction, and the same is claimed for all the accessories of the system on all other products of the company's factory.

The alternator is of the inductor type, in which all windings are stationary, the alternations being produced by rotating, magnetized iron masses in front of the armature coils. It is mounted on a solid frame, and provided with means for tightening the belts. The bearings are large and self-oiling. A perspective view of this machine is shown in one of the illustrations, Fig. 1. The field-magnet spool is shown in another cut, Fig. 2. This it will be noticed is solidly attached to the structure, and around it, rigidly mounted on a cast-iron spider, are the laminated armature cores supporting the coils. In Fig. 3 is given a view of the rotary part of the alternator, the inductor. On the shaft are mounted a core and end plates. The portion of the end plates facing the armature coils are star-shape, so as to produce fluctuation of magnetism through the coils. When all the coils of the armature are connected in series a pressure of 2000 volts is produced; if connected in parallel, or if each side is operated independently, the standard machine will yield a current under a pressure of 1000 or 1100 volts. The same machine can be utilized for isolated plants connected up for 500-volt distribution, or for low-tension work without transformers at 220 or 110 volts. The inductor coils are machine-wound, and are constructed independently from the core. They are therefore easily removed and replaced. The cross-section of the armature coils is so calculated that the energy wasted in them is a very small percentage, and ensures close regulation. They are wound independent of the core, and provided with extra heavy insulators. About 1 per cent.

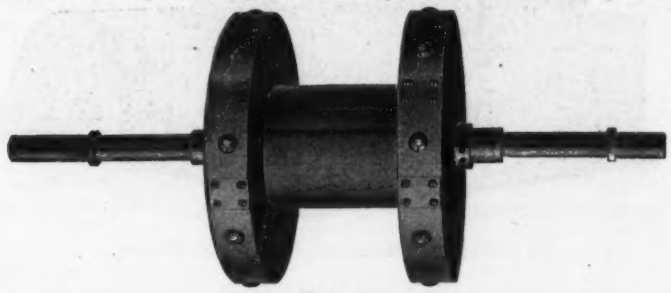


FIG. 3.

of the output of the machine is all that is necessary for field excitation, and in some cases even less than that amount is so used.

The Royal Electric Company makes standard alternating-current dynamos in seven sizes, ranging in capacity in 16-cp lights, from 500 to 2000. The exciter is made in two sizes. It is simple in design and construction, and of the upright magnet type.

Fig. 4 represents the switchboard for a single unit, or machine. The indicating instruments at the top are illuminated by incandescent lamps provided with reflectors, and centrally mounted between them is the switchboard transformer, below which are the two main fuses. The rheostat for the regulation of the exciter, the ground detector and main

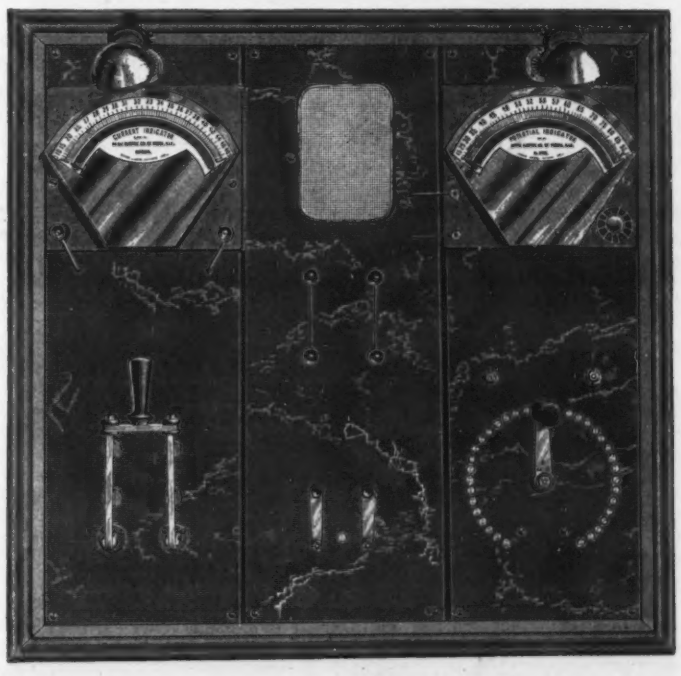


FIG. 4.

circuit switch are located respectively at the lower right-hand, middle and left-hand sections of the board. In the Royal transformer the iron losses are very small, and windings of ample capacity are used. The

company makes 12 standard sizes, varying in capacity from 10 lights to 500 lights. The primary fuse plugs are easily accessible and so constructed that fuses can be quickly substituted. The secondary is wound so that it can be connected to yield a current under a pressure of either 50 or 100 volts. The transformers are carefully constructed, and are subjected to a severe test as regards the insulation of the primary, secondary and core from each other before shipment.

Besides the transformers above referred to the company manufactures one of a special type for alternating-current arc lamp use, and has the facilities for turning out step-up and step-down transformers from special designs, as well as others for special work. It claims for its alternating-current system simplicity, durability, efficiency and economy.

A New Edison Phonograph.

The recent announcement that Mr. Edison had bought back from the receiver the property and rights of the North American Phonograph Company is followed up by the placing on the market of the new Edison phonograph here illustrated. This machine is being built at the Edison Phonograph Works, at Orange, N. J., and will be handled by the National Phonograph Company.

The new machine conforms in a general way to the older type, but it

Phonograph Operated by Spring Motor.

has two decided elements of novelty. One is that it is operated by a spring motor, and the other that it is to be sold at a low price. Mr. Edison has found that many people are still unable to avail themselves of street current for the dearer phonograph run by electric motor, or else are very averse to bothering with primary batteries, which few of them understand. Hence he has deemed it advisable to build this new phonograph, which is driven by a simple double-spring clockwork mechanism packed away snugly under the lid of the box. The phonograph is similar in design to the standard instrument, but is in reality lighter, and thus runs with less frictional loss. The machine is fitted with a handsome oak case, having a removable half-round top and a drawer for supplies. The machine is fitted for reproducing only, but for a small extra charge it is also built to record, or to do both.

Machine Shop "Kink."

Many careless workmen make a practice of striking the vise of a shaper with a hammer or anything else that happens to be handy in order to bring it up square, thus bruising the sliding surfaces and in a short time practically ruining the vise for efficient work. The evil effects thus produced are very plainly shown in the lower engraving, showing an old vise subjected to just such usage. To prevent this, Gould & Eberhardt, of Newark, N. J., have been making the new and original style of vise shown in the illustration above the old vise. This new vise is furnished

New Vise.

with all their shapers of latest design, and does not lessen the usefulness or reduce the capacity of the machine. In this vise, provision is made whereby it may be tapped on the end for such fine adjustment as may be required without in the least injuring the vise in any way. To keep the matter continually before the workman, the makers have cast the word "Strike" on the vise, also arrow-points showing where to strike.

Feed-Water Heater and Purifier.

Every progressive engineer knows the value of a feed-water heater when used in connection with a steam generating plant, and few first-class plants can be found these times without them. The use of feed-water heaters means the saving of nearly 1 per cent. in fuel for every 10° added to the temperature of the feed-water by exhaust steam. It requires a simple calculation, therefore, to demonstrate that a saving of over 13 per cent. in fuel is effected by the use of a feed-water heater delivering the feed-water to the boiler at a temperature of from 208° to 212°, the average temperature of the water supply being 60° F. Hence, feed-water heaters are economizers, either through saving fuel or by increasing the steaming capacities of boilers.

The Cochrane heaters, made by the Harrison Safety Boiler Works, Philadelphia, Pa., are designed to give every advantage that can be obtained from exhaust steam for heating and purifying water. They are made of cast steel, and are constructed with due regard for strength, durability, facility of cleaning, and ease and reliability of operation.

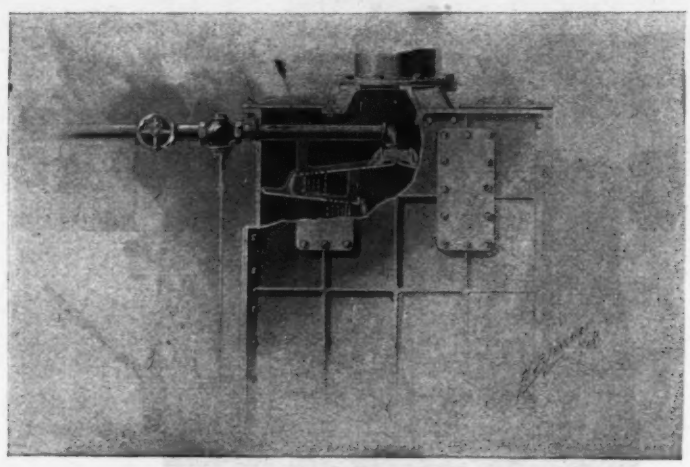


Fig. 1.—Feed-Water Supply.

These heaters are equipped with the Cochrane oil separator, which gives complete protection from cylinder oil.

The exhaust steam enters the heater through the oil separator, which thoroughly frees it from the cylinder oil, or lubricant. The steam then ascends through the heater, surrounding and passing between the trays, which quickly acquire the temperature of the exhaust. The cold water becomes finely divided in passing from tray to tray (see Fig. 1), and at the same time constantly absorbs heat while falling through the current of exhaust steam.

Fig. 2 shows the manner in which the cold water is introduced, the automatic regulating valve for controlling the supply being shown on the left hand.

Provision is made for easily examining and cleaning all parts of the heater without disturbing any pipe connections.

The claims made for these heaters are, that they give complete protection from cylinder oil carried in the exhaust steam; given sufficient exhaust steam they will deliver feed-water at a temperature of from within

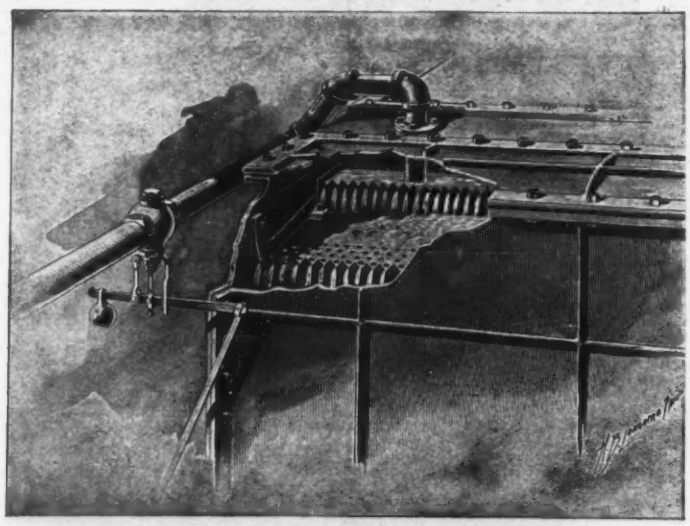


Fig. 2.—Automatic Supply Valve.

two to five degrees of the temperature of the steam entering the heater; they give all the purification that can be obtained by heating water to the temperature of exhaust steam, and by furnishing large depositing and settling surface; they reduce, when in operation, the back pressure in the exhaust main; automatic regulation of cold water supply; ease of operation, durability and freedom from repairs.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, April 4, 1896.

AMERICAN BELL TELEPHONE.—At the annual meeting of the American Bell Telephone Company, held in Boston on March 31, Chairman *pro tem.* William H. Forbes, referring to the increase in capital stock, said it was necessary to meet the extension and increasing business of the company. The sale of 21,500 shares at $200 per share would yield about $4,300,000, and the necessities of the company during the coming year will just about absorb that amount of capital.

GENERAL ELECTRIC AND WESTINGHOUSE.—It is reported that the contract between the General Electric Company and the Westinghouse Electric & Manufacturing Company, providing for an exchange of licenses under their patents, was executed and delivered in Boston on April 1. Both sides look upon the arrangement as an admirable one in the interest of the stockholders of both companies.

THE NEW YORK & NEW JERSEY TELEPHONE COMPANY has declared a quarterly dividend of 1½ per cent., payable April 15.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	96	98½
" " " Brooklyn	100	100	102½
" " " Boston	100	135	140
" " " Philadelphia	100	131	131¼
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29¾	30⅛
Electric Storage, pref	100	30½	31
General Electric	100	37	37⅛
General Electric, pref	100	72	..
Westinghouse Consolidated, com	50	30	31
" " pref	50	52	53

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90½

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	202	202½
American District Telegraph	100	33	40
American Telegraph & Cable	100	92	95
Central & South American Telegraph	100	124	127
Commercial Cables	100	157	..
Erie Telephone	100	59	61
New England Telephone	100	88½	89
Postal Telegraph-Cable	100	86	..
Western Union Telegraph	100	84⅛	84¼

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17⅜	17⅝
Brooklyn Rapid Transit		20¼	20⅜
Brooklyn Traction	100	13	14½
" " pref	100	45	47
Buffalo St. Ry	100	70	73
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	45	47
Hestonville	100	47	..
" pref		..	62½
New Orleans Traction	100	16	18
" " pref	100	63	66
North Shore Traction	100	28	31
" " pref	100	77	80
Rochester St. Ry	..	28	33
Steinway, Ry	..	45	50
Union Railway (Huckleberry)		98	.
Union Traction, rcts $10 pd	..	15	15⅛
West End, Boston	100	68½	69
" " pref	100	89	90
Worcester Traction	100	15	17
" " pref	100	87½	89½

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	81	..
Buffalo St. Ry. 1st con. 5s	100	105	107
Cleveland Elec. Ry. 1st mtge 5s	100	100	103
*Columbus St. Ry. 1st 5s	100	111	112
Rochester St. Ry. 1st 5s	100	99½	102
Union Railway (Huckleberry) 1st mtge 5s		103	105½
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

TRACTIONS.—The prevailing dullness in tractions was broken last week by some activity in Buffalo railway stock, and a somewhat lower range of prices has been established. Reports of a contemplated strike of the company's employees are responsible for the decline. As a consequence of this report the stock declined during the week to around 71, but as the rumors of a strike were not confirmed, the stock advanced somewhat and closed about a point higher. The reported disagreement among the officers of the Worcester Traction Company has, it is said, been settled, and the company will operate under the same management as before. The endeavors of the Brooklyn Heights and the Nassau Electric lines and Brooklyn elevated roads to obtain the privilege of running their cars over the Brooklyn Bridge are of great interest to the stockholders of the various companies. The Brooklyn Heights interests are reported to be negotiating with the Metropolitan Traction Company of this city for a system of transfers, while Mr. Flynn, of the Nassau Electric Company, is said to have made arrangements with the Third Avenue surface road for the same purpose.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, April 6, 1896.

DR. SCHUYLER S. WHEELER has just returned to the city after a tour through Florida.

MISS EDNA EARL JOHNSON, eldest daughter of Mr. E. H. Johnson, president of the Interior Conduit & Insulation Company, is to be married on April 22, to Mr. George Quintard Palmer.

C. S. VAN NUIS, 136 Liberty Street, will move his office to his factory at 43 Cortland Street. He will then be enabled to transact his business with greater facility than is now possible, with factory in one building and office in another.

MR. E. H. JOHNSON, president of the Interior Conduit and Insulation Company, will sail for Europe on June 6. During the trip Mr. Johnson will combine business with pleasure. He is not expected to return until November. English capitalists are anxious to manufacture in that country interior conduit tubing under Mr. Johnson's patents, and the matter will probably be arranged during the trip.

THE MUTUAL LIFE INSURANCE COMPANY, OF NEW YORK, will, until further notice, accept risks on the lives of electrical engineers of at least one year's experience, at the ordinary rates, without extra premium. By the term "electrical engineers" is meant consulting electrical engineers, and men having independent charge of a dynamo, or holding a still higher position in connection with an electrical plant.

AT A MEETING of the stockholders of the Phœnix Interior Telephone Company, held at its office, at 131 Liberty Street, on March 25, the following directors were elected for the ensuing year: Heinrich Meyer, Jas. L. Sharp, John H. Scofield, Geo. W. Sutton. Arthur E. Walradt, L. Lambetet, and Wright C. Stout. At a subsequent meeting of the Board of Directors Geo. W. Sutton was elected president, Jas. L. Sharp, vice-president, and John H. Scofield, secretary and treasurer.

MR. JAMES I. AYER, general manager of the American Electric Heating Corporation, of Boston, has been spending a few days in New York on the business of the company. Mr. Ayer says that the American Electric Heating Corporation will soon introduce several new heating devices. The corporation is about to open an office in Chicago, which will be in charge of Mr. Frederick P. Luther, formerly manager of the Western Electric Heating Company, of St. Paul. The manufacturing at present done by the St. Paul Company will be transferred to the East. Mr. L. L. Parsons is the New York representative of the American Electric Heating Corporaiton.

CARPENTER ENAMEL RHEOSTATS AND HEATERS.—At the coming electrical exhibition, the Carpenter Enamel Rheostat Company, Hoboken, N. J. will exhibit various types and sizes of field regulators, theatre dimmers, motor starters, motor regulators, reversing controllers for traveling crane service and elevator service, and similar uses; automatic rheostats opening both from failure of current and upon overload; and many forms of special rheostats for various uses. It will also exhibit a full line of electrically heated tools, such as soldering irons of various sizes, and for all voltages from 50 volts to 500 volts; a similar line of flat irons; curling iron heaters and various other types of electrically heated appliances.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Brooklyn, on the night of March 25 held its annual reception and exhibition at its Pearl Street station. A large gathering was present, including Mr. Thomas A. Edison, R. R. Bowker, of the New York Edison Company; Prof. W. C. Peckham, Mr. and Mrs. W. S. Barstow, Mr and Mrs. Charles A. Schieren, Clinton L. Rossiter, and Seth Low. Prof. W. C. Peckham gave a practical illustration of making pictures with Roentgen rays, and showed several plates of objects, including a mouse. The animal's heart and kidneys were plainly visible. Other exhibits of interest were an automatic electric piano, which played popular music throughout the evening and attracted much attention. The electric flower decorations and electric heating and cooking apparatus were also popular features. In the electric cooking department were shown electric tea kettles, portable stoves, three-section broilers, coffee pots, hot-water urns, curling iron heater and electric smoothing irons. Among the exhibitors were the Edison Miniature Lamp Company, Thomas Boyes, electric flowers; Automaton Piano Company and E. Faulkner. The general offices were prettily decorated with flowers set with several hundred miniature lamps. Over the doors several beautiful electric pieces were hung. At the rear end of one of the halls was a ship scene, entitled "Homeward Bound," made by E. Faulkner, 303 Adams Street, Brooklyn. The picture represented a ship riding briskly before the breeze, while the moon, represented by a miniature light, showed above.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
927 Chestnut Street,
PHILADELPHIA, Pa., April 3, 1896.

MR. T. W. MONKHOUSE, of the Reliance Electric Company, 724 Sansom Street, who has been confined to his home for the past three months by serious illness, we are glad to hear is much better, and will soon be out again. The business has been carried on in his absence by his brother, who reports that it is very good.

THE CUTTER ELECTRICAL MANUFACTURING COMPANY, 1112 Sansom Street, is preparing for circulation a beautifully illustrated catalogue, which will be ready about April 15, and will consist of about 30 pages, and about 25 illustrations of C.-S. flush switches and accessories. It will also issue, very soon, a nice catalogue of "I.-T.-E." automatic magnetic circuit-breakers. These catalogues will be sent free to any one applying for them. The I.-T.-E. automatic magnetic circuit-breakers have received the approval and endorsement of the National Board of Fire Underwriters.

PARTRICK & CARTER COMPANY, 125 South Second Street, Philadelphia, one of the oldest established electrical supply houses of the country, has issued its 1896 catalogue, which is a very complete one. This house enjoys an envi able reputation on account of its patent needle annunciator for hotels, houses, steamers, cars, etc. These annunciators are made in various designs, according to the use intended. Its hallway hotel fire-alarm system is complete and reliable. Over 40,000 hotels, dwellings, offices, banks and business establishments throughout the United States and Canada are using Partrick & Carter needle annunciators. They are also used on United States warships. The company manufactures and carries a large line of electric light supplies and general electrical goods for house work.

THOS. C. WARLEY & CO., sole manufacturers of the celebrated Lord's patent improved and Warley's land, marine and locomotive boiler cleansing compounds, No. 11 South Ninth Street, report that they are meeting with great success in the sale of their goods, and are daily receiving testimonials from customers of the excellent results attained by the use of the compounds, both for the prevention and removal of scale. They attribute the success to the fact that their compounds, being of a non-volatile nature, will not pass over with the steam, and having neither taste nor odor, they can be used with perfect safety in all kinds of boilers, and that they vary the compounds to meet the requirements of each individual case. This firm has gained an enviable reputation among the steam users of the United States and foreign countries for the high quality of their goods.

NIAGARA FALLS NOTES.

NIAGARA FALLS, N. Y., April 2, 1896.

QUITE A NUMBER of men prominent in the commercial as well as practical part of electrical development of this country were here this week, some to look after their interests, and others to see if they cannot do something more to boom electrical power at the Falls.

THE NIAGARA FALLS POWER COMPANY, in addition to furnishing electrical power to the Pittsburg Reduction Company, the Carborundum Company and the Buffalo & Niagara Falls Electric Railway, has turned on a current for the local street railway, and another for the Buffalo & Niagara Falls Electric Light & Power Company, which latter company lights the city.

THE PITTSBURG COMPANY intend to extend its plant on the upper river immediately and increase the capacity. The General Electric Company, which put in the transformers for the Niagara Falls Power Company at the Pittsburg plant to change the alternating-current to the direct, are to replace them very soon with new ones. In regard to the power received from the Niagara Falls Power Company by the Pittsburg Reduction Company, Capt. Hunt said: "It is most satisfactory, as is also our yield of metal, under Mr. Hall's direction. This latter is constantly increasing. The electrical power at Niagara is much superior to anything we have been able to generate under steam at Pittsburg, where coal can be secured very cheap."

CAPT. ALFRED E. HUNT, of the Pittsburg Reduction Company, was here last Saturday. As intimated in previous articles on the establishment of a new plant of the Pittsburg Company in THE ELECTRICAL WORLD, it is proposed to conduct the electricity from the generators in the power house to the furnaces of the Aluminum Company by means of aluminum wire instead of copper. The company has had a number of experts making tests, and the reports from these will be in the hands of the company this week. Capt. Hunt says that all were in except one, and that he knew the tenor of that report. All were agreed that the direct current could be most successfully conducted from generator to furnace. The distance is less than 200 feet and the tests have given surprising results.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., April 3, 1896.

CROWN WOVEN WIRE BRUSHES.—Owing to increasing business the Crown Woven Wire Brush Company, of Salem, Mass., have moved into the new Powers block, where they have a model factory and hope to make even better brushes than heretofore. Their Crown "K" brushes in particular are meeting with great success. They are not only selling their goods in the United States but are sending them to Mexico and Canada and hope very soon to place them on the English market. Their new factory, which is especially adapted to their business, will enable them not only to increase their output but to compete with any goods in the world in quality and price.

L. A. CHASE & CO., (incorporated), 161 Fort Hill Square, Boston, Mass., describe in a very artistically designed catalogue their business and manufactory. This concern makes electrical repair work their special business, and in the prosecution of their work high-grade technical ability and practical skill are employed. The factory is equipped with the best modern machinery for all classes of repairs to dynamos, motors and other electrical apparatus. Special attention is given to armature rewinding, and every workman in the employ of the company is skilled in his particular line, thereby insuring the best results. A very complete testing department forms an important and valuable feature of the business. The factory is well illustrated by half-tone engravings.

MR. JUSTIN J. GATES died at his residence at Hartford, Conn., on Thursday morning, April 2, of typhoid fever, after a brief illness. His funeral occurred on Saturday, April 4, services being observed both at his Hartford residence and at the home of his parents at Hadlyme, Conn., where his remains were interred. Thus is removed suddenly and unexpectedly a valued member of the electrical fraternity, and one who was actively and prominently identified with the business for upwards of 10 years. His first position was with the Mather Electric Company in its early days. Afterward as organizer and chief executive of the Perkins Lamp Company, identifying himself later with the Waring Electric Lamp Company, the Royal Arc Lamp Company, and more recently as general manager of the Perkins Electric Switch & Manufacturing Company, which position he not long ago resigned. At the time of his sickness he was engaging in business for himself, incidently disposing of a large number of incandescent lamps purchased from the receiver of the Waring Lamp Company, and preparing to enter into the manufacture of incandescent lamps on a large scale through a new and important vacuum process, reducing greatly the cost of manufacture. Mr. Gates was a man of admittedly remarkable abilities, possessing a valuable practical knowledge of the electrical business generally, and particularly of incandescent lamp manufacture. He possessed business qualities of a high order, and a wonderful degree of energy and pluck, all of which served to make certain the success he always secured. Personally he was universally liked and highly esteemed by all for his many noble qualities of heart and mind, and his untimely death will occasion general and sincere regret. His funeral was largely attended, the services at his residence attracting his business acquaintances and friends, and the services at the old homestead those who had known him since childhood. Mr. Gates had just passed his 33d year, and leaves a widow and two children. He belonged to the City Guard Batallion of Hartford, and was a member of the Masonic fraternity and several fraternal orders, all of which were represented at the funeral.

WASHINGTON NOTES.

WASHINGTON, D. C., April 3, 1896.

SENATOR BUTLER, of North Carolina, has introduced a bill in the Senate to establish a postal telegraph system, and to enlarge the postal facilities of the people of the United States. The bill has been laid on the table.

THE INTEROCEANIC RAILWAY COMPANY.—The bill to amend an act to authorize the Interoceanic Railway Company to construct and operate railway, telegraph and telephone lines through the Indian Territory, has passed the House, and has been introduced in the Senate by Senator Jones, of Arkansas. The chief amendment makes the City of Fort Smith the terminus of the road on the western border of the State of Arkansas.

THE PAINTON ELECTRICAL STEAMSHIP & CONSTRUCTION COMPANY was granted a charter at Alexandria, Va., this week. The capital stock is $1,000,000. The object of the company is to build ships to be propelled by electricity or steam in conformity with certain patents. The officers are all from Williamsport, Pa., and are as follows: President, P. B. Painton; Vice-President, J. W. Bailey; Secretary, H. A. Solomon and Treasurer, Hiram Warren.

REPRESENTATIVE H. W. RUSK, of Maryland, has introduced a bill in Congress to incorporate the Columbia Subway Company. The capital stock of the company will be $500,000, and it will have authority to own and control in the public streets, avenues, roads and alleys a subway and conduit for the use of all incorporated companies, telegraph companies, telephone companies, electric light companies, and all other companies that are required to use wires in connection with their business. The subways are to be built under the direction and supervision of the District Commissioners, and all wires on or over the streets, avenues and alleys when such a subway is laid, must be removed or placed in the conduit or subway within 30 days after the completion of the subway, under the penalty of $10 a day for each wire and every pole carrying an overhead wire that remains on road, street, avenue or alley. The shares of the company will be $50 each, and those interested in the corporation are: T. Barton Jones, G. C. Schuermann and John Henry Keen, of Baltimore, and A. W. Fletcher, H. C. Lybrand, H. J. Finley and Charles Eisenstein, of Washington, D. C. The bill has been referred to the Committee on the District of Columbia.

RECEIVER ASKED FOR.—An application has been made in the United States Circuit Court in Baltimore by E. D. Smith & Son, one of the controlling firms engaged in building what is known as the Boulevard electric road between Washington and Baltimore for a receiver for the Baltimore & Catonsville Construction Company and the Columbia & Maryland Railway Company. The petitioners say they were awarded the contract for constructing and equipping the road, which they were to have completed by March 2, 1896. One half of the payment was to be in cash, and one half in the bonds of the Columbia & Maryland Railway Company at the rate of 90 cents on the dollar, which bonds were to be a first lien on the property of the company. The firm did four months' work on the road at a cost of $140,895 for labor and material furnished. Smith & Son allege that neither the Construction Company, the Columbia & Maryland Company, the Edmondson Avenue, Catonsville & Ellicott City Electric Railway Company nor the Maryland & Washington Railway Company, all constituent companies, have charter powers, nor do they collectively have charter powers to build a line of road, and for that reason the road could not be validly mortgaged. The firm say they are creditors of the construction company to the amount of $70,447 80 on account of work and material. Work on the road was stopped at Hyattsville this week, because of an injunction taken by the Holliday Land Company, which claims the railway is unlawfully occupying land belonging to it.

NEW ORLEANS NOTES.

NEW ORLEANS, LA., March 28, 1896.

W. H. CHAPMAN has been appointed superintendent of the Louisiana Electric Light Company, in place of Alfred Raymond, resigned. Mr. Chapman was formerly connected with the Cleveland Illuminating Company, Cleveland, O.

THE CONTRACT for the erection of the electric lighting and water works plant at Franklin, La., reported in these columns some weeks ago as having been awarded to the New Orleans Railway & Mill Supply Company, has since been awarded to the firm of Raymond, Stearnes & Gray.

ON SATURDAY, March 28, the electrical and mechanical students of Tulane University carried out an extensive and elaborate test at the power house of the Orleans Railway Company, in New Orleans, and determined the electrical and mechanical efficiency of the plant. The tests were conducted under the direction of Prof. Brown Ayres.

THE MERCHANTS' ELECTRIC LIGHT & POWER COMPANY, recently organized in New Orleans, is now in the market for electrical apparatus. As soon as negotiations are completed for the purchase of a proper site for the plant, which will be some time in April, the work of construction of the plant will be pushed forward as rapidly as possible. Direct-current apparatus is preferred. The plant is to have an initial capacity of 1000 horse-power, and to contain one unit of 500-light capacity, and two other units of half this capacity. A 100-light arc machine is also contemplated. Mr. W. H. McFall is the electrical engineer.

THE CITY COUNCIL has ordered that the iron towers erected some years ago for the purpose of carrying all the electric wires shall be torn down, as they have become a menace to life and property. These iron towers have always been an object of curiosity to visitors to New Orleans. Some years ago the City of New Orleans took steps to compel the burying of all electric wires. This would have been an extremely difficult and expensive task on account of the great amount of water in the soil of New Orleans. To avoid this expense the Louisiana Electric Light Company proposed the erection of large electric light towers at the intersection of streets, and the stringing of all wires thereon. This proposition was adopted, and the towers were erected at the expense of the Louisiana Electric Light Company. These towers have stood several years, but not a single wire has ever been strung upon them, as the plan was such a manifestly absurd engineering scheme. Now that the towers are getting old and becoming weak and dangerous, the Council has ordered their removal. This action the Mayor has vetoed, giving as a reason that the towers are the property of the Louisiana Electric Light Company, and the Council has no authority to remove them. The expense of these towers is one of the numerous burdens borne by the Louisiana Electric Light Company, and one of the reasons why it is now in the hands of receivers.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., April 3, 1896.

W. F. HOLD has disposed of his electrical supply and construction business in Bay City. Mich., and is now with the Chicago General Fixture Company, 169 Adams Street, Chicago.

MR. W. D. GRAVES of the Graves Electrical & Machine Works, manufacturers of arc lamps and switches, 19 Michigan Street, Cleveland O., reports business excellent, having run his factory night and day a great portion of the Winter, in order to fill orders promptly.

THE GARTON-DANIELS ELECTRIC COMPANY, Keokuk, Ia., is meeting with the usual large Spring demand for its arresters These arresters have been recently adopted by some large manufacturers, as well as numerous leading street railway companies and central stations, and are holding up their reputation for efficiency and durability.

THE DETROIT ELECTRICAL WORKS.—It is reported that L. Warfield and William A. Jackson, of the Detroit Electrical Works, Detroit, Mich., have been awarded a verdict of $283,750 against William A. Boland of Boston, and Frank A. Barnabee, of Providence, R. I., on an alleged breach of contract in connection with the reorganization of the company.

THE NEW YORK & OHIO COMPANY, Warren, O., who have been making a specialty of Crookes tubes for X-ray work, report achieving excellent results, good photographs having been made with the tubes by an exposure of only one minute. Their tubes are made of German glass, and every tube is tested in actual work before being sent out.

THE SUNBEAM INCANDESCENT LAMP COMPANY, Chicago, are making a lamp for sign and decorative purposes, which they claim no other lamp company has yet been able to make. They have two styles; 4 cp 20 watt, for any voltage up to 120, which is the lamp mostly used in signs and decorative lighting, and a 2 cp 10 watt lamp in voltages from 50 to 60. These lamps have bases to fit the regular standard sockets. and they can be connected in multiple on the ordinary lighting circuits. They are meeting with a large demand.

"IN TIME OF PEACE PREPARE FOR WAR."—The Electric Appliance Company has closed arrangements for the agency of the Dayton electric ceiling fan and has a complete line of these fans in operation at its salesrooms at 242 Madison Street, Chicago. The Dayton Company make a very attractive line of these goods, including a handsome electrolier and column fan. Some of the special points claimed for the Dayton fans aside from their artistic finish are that they have four blades, run at a high speed, and have a very high efficiency.

MR. G. R. SCRUGHAM, superintendent of construction department of the Craighead Engineering Company, electrical engineers and contractors, Cincinnati, O., stated to a representative of THE ELECTRICAL WORLD in Cleveland, O., last week, that he was just returning home from a trip East as far as Boston, and that the Craighead Flexible Bracket is meeting with great success, having booked several orders on his recent trip. This company has also booked a large order from Santa Fe, Argentine Republic, for mast arms. Mr. Scrugham states that business with his company is better than it has been for the past four years.

General News.

NEW INCORPORATIONS.

THE UNIVERSAL LIGHT & POWER COMPANY, St. Louis, Mo., has been organized by M. Niebling and A. F. Beasley, with a capital of $24,000.

THE REITH ELECTRIC COMPANY, of Chicago, has been organized by Robert D. Rowe, Peter Reith and John M. McNabb, with a capital stock of $4000.

THE CADIZ RAILWAY COMPANY, Cadiz, Ky., has been incorporated by W. C. White, Dr. J. W. Crenshaw, B. F. Goodwin, G. G. Terry, D. L. Grinter and M. S. Thompson.

THE KINGS COUNTY TRACTION COMPANY has been organized in New York by R. F. Vaughan and J. H. Lockman, of Brooklyn, and J. A. Snyder, of New York. Capital stock, $6,000.

THE ELECTRIC SCENIC COMPANY has been organized in New York City, with a capital of $20,000. The directors are George W. Bittbridge, W. S. Munn, P. Smith and others of New York City.

THE OCTORARO TELEPHONE & TELEGRAPH COMPANY has recently been established in Oxford, Pa. It is composed of local capitalists, and will extend its lines to different places in the vicinity.

THE HARDIN COUNTY TELEPHONE COMPANY, Ackley, Ia., has been formed with a capital stock of $25,000. The incorporators are C. E. Albrook, J. D. Newcomer, C. E. Greef, W. S. Porter and C. F. Bennett.

THE VOLTA ELECTRIC COMPANY, of New York, N. Y., has been incorporated by Paul A. Curtis, E. W. Carhart and John Potts, to manufacture, sell or deal in electric and storage batteries. Capital stock, $10,000.

THE AUTOMATIC ELECTRIC PUMP COMPANY, Portland, Me., has been incorporated with a capital stock of $100,000. The incorporators are George F. Atwood, Elmar A. Messenger, Boston, Mass., and Frank E. Hawkes, Portland Me.

THE FLEMING-SPENCE ELECTRIC COMPANY, of New York, has been incorporated with a capital stock of $100,000. The directors are Richard Fleming, Jersey City, and William H. Spencer and Thomas J. Fleming, of New York City.

THE RAPID CITY GAS, ELECTRIC LIGHT & FUEL COMPANY, Rapid City, S. D., has been formed with a capital stock of $150,000. The incorporators are L. L. C. Brooks, St. Paul; Wm. Kennedy, Des Moines, and Edward Smith, Rapid City.

THE REDWOOD CITY ELECTRIC LIGHT COMPANY, Redwood City, Cal., has been incorporated by George H. Rice, Robert Brown, Ludwig J. Behrens, George C Ross, Redwood City, and Charles Josselyn, Woodside, Cal. The capital stock is $50,000.

THE PORT CLINTON ELECTRIC LIGHT & POWER COMPANY has been incorporated in Port Clinton, O., with a capital stock of $10,000. The incorporators are M. A. Clemons, L. S. Porter, C. L. York, E. H. Fall, Chas. E. De Witt, and S. A. Magruder.

THE SURBURBAN ELECTRIC RAILWAY COMPANY, Geneva, Ill., has been incorporated by G. I. Talbot of De Kaib, C. L. McMurray, H. H. Galvin, of Chicago, and others. Capital stock, $250,000. The road is to connect cities in Cook, Lake, Du Page and Kane Counties.

THE ELECTRIC LAMP COMPANY, Buffalo, N. Y., has been organized with a capital stock of $100,000. The directors are Thos. H. Spaulding and J. R. Keim, of New York City; T. F. Crean, of Brooklyn; H. H. Fulton, of Elmira, and D. L Whittier, of Indianapolis.

THE TORRINGTON TOWN COMPANY, Colorado Springs, Col., capital stock, $100,000, has been formed by J. Arthur Connell, William A. Otis, William A. Bell, Colorado Springs, for the purpose of laying out town sites, furnishing electric light and water and making other improvements.

THE FLUSHING TELEPHONE COMPANY, Flushing, O., has been formed with a capital stock of $3,000, for the purpose of furnishing communication by telephone or other electrical device. Among those interested are F. J. Mead, E. W. Shallcross, J. A. Hobson, A. B. Hobson and F. M. Cowen.

THE PUEBLO ELECTRIC COMPANY, Pueblo, Col., has been formed for the purpose of carrying on a general electrical business, dealing in fixtures and supplies of all kinds, operating plants, etc. Those interested are F. A. Kettler, N. W. Kettler, F. L. Cudderback, Pueblo, Col. Capital stock, $10,000.

THE W. S. HILL ELECTRIC COMPANY, New Bedford, Mass., has been organized for the purpose of manufacturing switches, switchboards, motors, dynamos and other electrical and mechanical apparatus. The incorporators are Rufus A. Soule, Charles S. Mendell and George R. Stetson. Capital stock, $60,000.

THE MASSASOIT GOLD MINING, MILLING, TUNNEL & TOWN SITE COMPANY, Denver, Col., has been formed by A. M. Beall, B. A. Bagley, B. C. Snitcher, H. D. Morton and William A. Riddle, for the purpose of laying out town sites, building electric lighting plants, water works, etc. Capital stock, $800,000.

THE ROCKWELL CITY ELECTRIC LIGHT & POWER COMPANY, Rockwell, Ia., has been incorporated for the purpose of buying, owning and operating an electric light and power plant. Those interested are E. C. Stevenson, A. F. Dean, W. Lewis, George B. Brown and J. W. Bradt. Capital stock, $10,000.

THE LONG BEACH & SAN PEDRO ELECTRIC COMPANY, Long Beach, Cal., has been incorporated with a capital stock of $50,000, for the purpose of dealing in electrical goods, furnishing electricity, etc. Those interested

are I. E. Tutt, E. S. Tutt, Charles C. Glass, Long Beach, and J. H. Braly, Los Angeles, Cal.

THE KURTZ NATIONAL TELEPHONE COMPANY, of Belleville, Ill., has been organized with a capital stock of $20,000, to put in 300 business telephones and 200 instruments in residences. A liberal franchise has been granted to W. J. Kurtz, who formed the Decatur, Ill., and St. Joseph, Ill., companies, of 600 instruments each.

TELEGRAPH AND TELEPHONE.

CALIFORNIA, PA.—The town will now soon be wired for telephones.

PENACOOK, N. H.—A local telephone service is shortly to be inaugurated here.

GADSDEN, ALA.—A telephone line will be built between this place and Attalla.

MARYSVILLE, TENN.—The Marysville Telephone Exchange is to be enlarged.

BRISTOL, VT.—South Bristol is soon to be connected with the village by telephone.

BARDWELL, KY.—A telephone line is to be erected between this place, Milburn and Arlington.

ALTON, N. H.—The construction of a telephone line connecting Alton and Wolfboro is being agitated.

PARKSTON, S. D.—The Aberdeen Telephone Company is contemplating extending its lines to several outside towns.

GLASGOW, KY.—A telephone exchange will be established in this place, a franchise having been granted for this purpose.

QUAKERTOWN, PA.—A movement is on foot to construct a local telephone system at once; also a fire alarm system for the town.

JUNCTION CITY, KAN.—A telephone company has been organized in this place and will be ready for business about July 1, next.

LOUISVILLE, KY.—The building of the proposed telephone between New Haven, Bardstown and Howardstown, in this State, is now assured.

MASON CITY, IA.—The Iowa Union Telegraph Company will extend its lines from this city to Austin, Minn., on the north, and to Hampton, on the south.

ELECTRIC LIGHT AND POWER.

RAHWAY, N. J.—The Rahway Electric Light & Power Company property is to be sold at a master's sale on April 28.

BOISE CITY, IDA.—The electric light company will double its plant capacity at a cost of from $15,000 to $20,000.

DUNLAP, IA.—The voters of this place have decided to have a municipal electric light plant, and bids for the same will be secured at once.

LEWISTON, ME.—C. F. Fitzgerald will probably build a lumber working plant in the Spring. It will be a large mill and run by electrical power.

DETROIT, MICH.—The Lighting Commission has asked for an appropriation of $180,322 for the running of the electric light plant and establishing 200 new arc lights in new territory.

MAPLETON, MINN.—C. H. Brown, of this place, has secured a franchise for an electric light plant. The D. & D. Electric Manufacturing Company, of Minneapolis, Minn., will supply the apparatus.

CARDINGTON, O.—The Fort Wayne Electric Corporation, of Fort Wayne, Ind., has secured the contract for the lighting of this place by electricity. The new plant will be in working order by June 1 next.

PORTSMOUTH, N. H.—Hon. Frank Jones is making arrangements to build an electric light plant for lighting his suburban residence and grounds, the brewery, the Rockingham and the Wentworth hotels.

HART, MICH., will soon have an electric light and water works plant. Specifications will be ready April 10, and bids will be received on April 21. Humphrey & Carr, engineers, of Detroit, have the matter in charge.

GRASS VALLEY, CAL.—The Nevada County Electric Power Company has purchased the plant and interest of the Grass Valley Electric Light Company and Casper's Electric Light Works in Nevada City. This removes all opposition from the field in this county, and gives the company control of all municipal-lighting contracts.

THE ELECTRIC RAILWAY.

THE CITIZENS' STREET RAILWAY COMPANY, of Kalamazoo, Mich., has been sold by the General Electric Company to local capitalists.

ELM GROVE, W. VA.—The projected railroad between Elm Grove and Triadelphia, which has been talked of for some time, will be constructed during the coming summer.

QUINCY, MASS.—The directors of the Quincy & Boston Street Railway Company held a meeting and voted to increase the capital stock to $165,000, and make extensive improvements to the line.

CAMBRIDGE, ME.—The town of Cambridge held a meeting for the purpose of voting $5000 to help build the extension of the Sebasticook & Moosehead Railroad from Harmony to that place, a distance of five miles.

DETROIT, MICH.—The Fort Wayne & Belle Isle Railway Company has increased its capital stock from $300,000 to $400,000 for the purpose of rebuilding its road on Monroe Avenue, Clark Avenue, River Street and Fort Street.

LONG BRANCH, N. J.—Applications were made to the Board of Commissioners for franchises for two trolley roads. One is through Red Bank, and the other is to come to Red Bank from Long Branch by way of Port-Au-Peck.

SOUTHBRIDGE, MASS.—The recently organized Southbridge & Sturbridge Electric Street Railway Company has made a contract with the Southbridge Electric Light Company to furnish power for the new railway. The proposed new road will be seven miles in length, and connect the village of Sandersdale, in Southbridge, with the village of Fiskdale, in Sturbridge.

YONKERS, N. Y.—A certificate of consolidation of the Yonkers Railway Company, the North & South Electric Company, and the Yonkers & Tarrytown Electric Railway Company was filed with the Secretary of State April 1. The name of the new corporation is the Yonkers Railway Company. The capital stock is $1,000,000, and the directors are Albert L. Johnson, J. M. Edwards, R. T. Wilson, Jr., John H. Ingram, and M. C. Wilson, of New York City; J. F. Van Name and Albert Crolius, of Brooklyn, and Channing Burnz, of Scarsdale. The company's principal office will be in Yonkers.

Trade and Industrial Notes.

THE WESTINGHOUSE MACHINE COMPANY'S orders for March include three vertical cross-compound engines, each of 1600 horse-power, for the Allegheny County Light Company's station, Pittsburg, Pa.

AHEARN & SOPER, Ottawa, Can., will hereafter represent the exclusive sale of the Westinghouse Electric & Manufacturing Company's apparatus in the Dominion of Canada, arrangements for that purpose having been made.

THE BATTLESHIP *Iowa*, which was launched at Cramps' yard, Philadelphia, March 28, is equipped with an entire outfit of Blake pumps, including fire pumps, feed pumps, bilge pumps, water service pumps, etc. The *Iowa*, like all the other battleship and cruisers built by the Cramps, will also be equipped with Blake vertical twin air pumps for the main condensers. These pumps are made by the George F. Blake Manufacturing Company, 95 and 97 Liberty Street, New York.

ALTHOUGH THE SEASON has scarcely opened, the demand for Wurtz's lightning arresters that is being made on the Westinghouse Electric & Manufacturing Company bids fair to be phenomenal. How popular this lightning arrester has become, and how well it has proved its efficiency, may be gathered from the fact that during 1894 the Westinghouse Company sold 9000 arresters, and in 1895, 12,000, while every indication for the present year promises to double the sales of last year.

THE LAKON COMPANY have recently issued from their Chicago office, 100 Washington Street, a circular entitled "How to Test Transformers," giving directions so that tests can be made at the ordinary central station without the need of laboratory instruments. The Lakon Company recommends that central stations should test every transformer purchased and the circular referred to shows what a wide difference there may be in the value of different transformers in consequence of their difference in efficiency.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., refers with justifiable pride to the prevention of a disastrous fire by some of their corrugated iron shutters. A fire occurred at the Russell & Erwin Manufacturing Company's works at New Britain, Conn. The building in which the fire started was separated from a very extensive building of the plant by a narrow driveway, but the fire was prevented from communicating with the latter building by the corrugated iron shutters. The building in which the fire originated was completely burned out.

THE WARREN ELECTRIC & SPECIALTY COMPANY, 670 West Market Street, Warren, O., is manufacturing an improved grade of incandescent lamp. In the company's first catalogue, just issued, the various styles of lamps manufactured by it are described and illustrated. The company, besides making standard lamps, manufacture miniature lamps of various voltages and designs; also a complete line of colored lamps. This company does not aim to make the cheapest lamp, but it does aim to make the best lamp, and it has all the facilities, experience and skill necessary to carry out its laudable purpose.

THE "WELLS LIGHT."—In the article on the kerosene torch, published in our issue of last week, two or three errors occurred. The name of the proprietor was wrongly given. Mr. Edward Robinson, 41 Washington Street, New York, is now the proprietor, the business having been turned over to him some time ago. It may be noted in this connection that no air compressor is necessary in the operation of the light. The oil is forced into the tank by the pump until the tank becomes two-thirds full, compressing the air already in the tank to about 25 lbs. pressure. A few strokes of the pump every few hours is all that is required to renew the pressure. Mr. Lemuel W. Serrell used these lights in laying a section of track at night in Plainfield, N. J., in order to evade an injunction. Our former notice read Camden instead of Plainfield.

AN EXTRAORDINARY BUSINESS CHANCE.—The Jones Brothers Electric Company, 32 West Court Street, Cincinnati, O., will, in order to give their entire time and energies to their light and power station, sell out their supply department, which they have conducted for the past ten years. This offers an excellent opportunity to any one who desires to continue the business, there being quite a large established trade, as well as considerable stock. The firm will sell the stock at 25 per cent. below the cost, the cost to be determined by their invoices of recent date, or by the invoices or *bona fide* quotations that could be shown by the purchaser. The stock includes a complete electrotyped catalogue arranged with trade word or cipher code, and a complete cost card system, which, together with the good will of the business, will be included free in the sale. This is the chance of a lifetime for some enterprising young man to get into an established business at a mere nominal cost and investment.

UNDERGROUND CABLES.—The National Underground Cable Company, Times Building has just been awarded a contract by the Toledo Traction Company, Toledo, O., for all the underground cables to be used by the latter company during the year 1896. This contract for underground cables is one of the largest ever given out in the United States, and covers cables for several kinds of service, including railway feeder, electric light and power distribution, and when finished will be the only system in the world in which series arc circuits and the three-wire system will be distributed from the same station.

The distribution will be done from one immense central station, and the sizes of cables to be used run from No. 6 gauge to over 1,000,000 circ. mils. The contract of the National Company covers also the work of laying and jointing and connecting of the cables and the furnishing of all apparatus to be used in connection with the underground system. The National Conduit Manufacturing Company, the associate company of the National Underground Cable Company, furnished all the underground conduits and built the complete subway system for the Toledo Traction Company. As a result of its continuously increasing business, the National Company's cable factories at Harrison, N. J., and conduit factories at Hastings-on-Hudson, N. Y. are compelled to run night and day to keep up with orders.

THE FERRACUTE MACHINE COMPANY, of Bridgeton, N. J., manufacturers of presses and dies and other sheet-metal tools, make a number of presses which are especially adapted for the electrical trade. Among others they build a number of open front presses for cutting armature discs up to 20 inches diameter; also a large number of round and square bed double-crank presses, the bed being placed between two columns. This seems to be the best form of press for cutting large circles for armature discs; also for sections of large discs, and this style seems to have proved very popular, the General Electric Company having seven of them in use, while many others are using them for electrical work. The Ferracute Machine Company also make an improved indexing machine for notching armature discs of various sizes, from 3-inch to 36-inch diameter. This is arranged with adjustable sliding head and with changeable index-plates, so that various numbers of teeth can be made in any size of disc. They are provided with a chuck and set of dies for any desired style of notch. They also make a number of sizes of their punching presses for cutting out instrument work and other goods in heavy metals, which have proved popular in the electrical trade. They expect to exhibit three or four presses at the electrical exposition in New York in May, and will probably have them running with an electric motor and manufacture a small article. They issue a handsome catalogue describing some 300 different presses.

Business Notices.

AN INVENTOR can have a practical, patented, electrical novelty placed on the market by communicating with Box 676, Syracuse, N. Y.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 31, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

557,099. MULTIPLE-SERIES SYSTEM OF ELECTRICAL DISTRIBUTION; F. B. Badt, Chicago, Ill. App. filed Sept. 25, 1895. The method of regulating a multiple-series system of distribution which consists of passing an electric current through the translating devices in multiple series, diverting a portion of the current from the overloaded side, passing said diverting current through an electric motor, opposing to the rotation of the motor a force independent of the current supply, and varying in accordance with the strength of the current flowing through the motor, and shifting said motor from one side of the system to the other, to maintain the same in circuit with the underloaded side.

557,114. TROLLEY POLE SUPPORT; N. H. Davis, Philadelphia, Pa. App. filed Nov. 8, 1895. A trolley-pole support having in combination a base-plate, adapted to be secured to a car, a plate having an annular flange, a bracket adapted to fit over the flange, said bracket having a cylindrical flange adapted to fit over the plate, an annular plate adapted to fit under the flange, and to be secured to the flange, and mechanism for supporting the trolley pole on a bracket.

557,121. MAGNETIC ORE SEPARATOR; O. M. Graves, North Yakima, Wash. App. filed June 17, 1895. In a magnetic ore separator, the combination with a frame and ore-conveyor, of an endless needle carrier above the ore conveyor, magnetic needles projecting from the carrier, and a vertical pivoted oscillating hammer in operative proximity to the edge of the needle carrier.

557,139. RAIL BOND AND ELECTRICAL CONNECTOR; C. E. Moore, Chicago, Ill. App. filed Oct. 9, 1895. A rail bond consisting of a conductor provided with a flange at each end, and a reduced portion projecting beyond the flange, and a sleeve to surround the reduced position, and means associated with sleeve and conductor so that the two parts are forced toward each other and thus expanded within the aperture of the rail.

557,153. APPARATUS FOR TELEPHONE LINES; C. E. Scribner, Chicago, Ill. App. filed Aug. 17, 1895. The combination with a repeating-coil having four helices arranged in two pairs whose members are serially connected, of a condenser included in a bridge between the points of junction of the members of the two pairs.

557,154. APPARATUS FOR TELEPHONE LINES; C. E. Scribner, Chicago, Ill. App. filed Aug. 17, 1895. The combination with a telephone line, of a local storage batttery at the substation thereof, a central source of charging-current connected therewith, a switch at the central station controlling the connection of the said source of current with the local storage battery, and means for controlling the switch from the substation.

557,159. ELECTRIC DENTAL PLUGGER; P. R. Skinner, Oneonta, N. Y. App. filed May 6, 1895. The combination of an electromagnet, an armature, a tool-holder whose reciprocations are controlled by the movement of the armature supply wires leading to and from the electromagnet, and a device for maintaining the continuity of the electric circuit between the terminals of the supply-wires, and the coil of the electromagnet comprising a swivel connection.

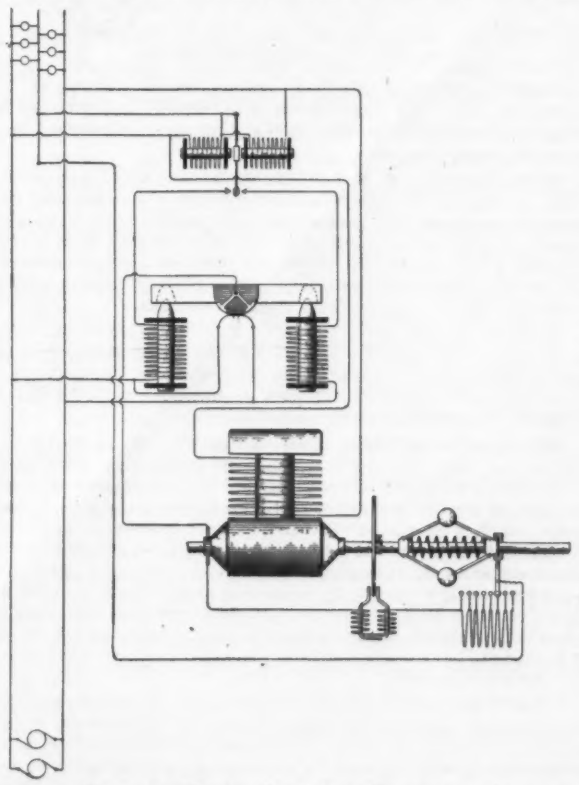
557,164. ELECTRIC METER; C. P. Steinmetz, Schenectady, N. Y. App. filed Jan. 15, 1896. A meter for measuring the consumption of energy in a monocyclic system, consisting of a field magnet coil connected in a series circuit relation with a load, means for establishing a phase relation of the E. M. F. corresponding to that of the supply mains, and an armature supplied by said means.

557,174. RAIL BOND AND CONNECTION; E. A. Turner, Chicago, Ill. App. filed Sept. 7, 1895. A rail bond comprising a conductor relatively small in cross-section area, an enlarged head at each end, said head tapered toward the extremity of the bond, sleeves correspondingly tapered inside and adapted to be driven into holes in the rail in one direction and to receive the enlarged ends of the bond when inserted from the opposite direction.

557,185. REGULATING ELECTRIC MOTORS; J. Burke, Newark, N. J. App. filed Sept. 4, 1895. The combination of a motor operated from a constant potential circuit, another dynamo-electric machine connected mechanically to the motor, the armatures of the two machines being in series, and a switch and rheostat for varying and reversing the field of the additional dynamo.

557,198. SNAP SWITCH; J. S. Gibbs, Hartford, Conn. App. filed Jan. 20, 1896. In an electric switch, in combination, a base bearing, contacts, binding parts and a number of ratchet teeth, a spindle, a commutator-block bearing conducting pieces adapted to connect the contacts on the base, a spring for throwing the block, a locking-bolt adapted to engage and disengage the teeth on the base, and a rack and pinion for moving the bolt.

557,218. COMMUTATOR FOR HIGH-VOLTAGE DYNAMOS; A. J. Oehring and H. H. Wait, Chicago, Ill. App. filed Aug. 20, 1895. In a commutator, the combination with a disc of wood, of segments secured to the face of said disc by screws passing through the segments and into the disc, but not passing completely through the disc, whereby there are no metallic portions upon the rear of the disc electrically connected with the circuit of the machine.



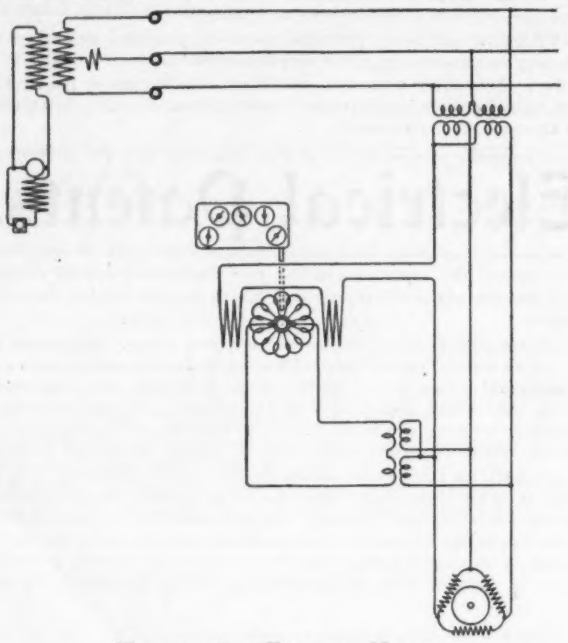
No. 557,099.—MULTIPLE-SERIES SYSTEM OF ELECTRICAL DISTRIBUTION.

557,224. ELECTRIC SWITCH; C. G. Perkins, Hartford, Conn. App. filed Jan. 2, 1894. In an electric switch, in combination, an insulating-base provided with a central threaded nut and bearing duplicate pairs of conducting poles, a spindle with a handle at one end and a screw thread at the other end, which fits and turns in the threaded nut in the base, an insulating commutator-block bearing conducting-poles and having a smooth-walled central perforation through which the spindle passes, a sleeve supported by and connected so as to rotate with the spindle, said sleeve having a positive connection with the commutator-block for rotating the same, and a pair of spring plates engaging the sleeve.

557,229. ELECTRIC ARC LAMP; W. D. Ray, Chicago, Ill. App. filed July 11, 1894. In an arc lamp, the combination with the carbon carriers supporting curved carbons and mounted to rotate about an axis, of an arm mounted to rotate therewith, a spring-pressed longitudinally-movable

sleeve mounted upon said arm, a roller carried upon said sleeve, and a cam-guide adapted to be engaged by said roller.

557,257. ELECTRIC CUT-OUT; R. G. Davis, Brooklyn, N. Y. and M. Torrance, Bennington, Vt. App. filed July 5, 1893. The combination of terminals adapted to be connected to a circuit, contact-posts intermediate the terminals, a fusible conductor connecting the contact-posts, pivoted arms connected with the terminals and adapted to be brought into or thrown out of engagement with the contact-posts at pleasure, springs secured at one end and having their free ends in contact with the shorter portions of the pivoted arms, and arranged to have a tendency in their normal position to hold the pivoted arms in contact with the contact-posts, and when the pivoted arms are revolved away from the contact-posts, and beyond the point of greatest depression of the springs, to hold the pivoted arms in their open position.



No. 557,164.—Electric Meter.

557,258. ELECTRIC RAILWAY; P. B. Delany, South Orange, N. J. App. filed Oct 10, 1892. The combination of a railway, a conduit, an electric heating wire arranged therein, and a conductor enveloping or partly enveloping the heading wire.

557,272. THERMOSTAT; W. S. Johnson, Milwaukee, Wis. App. filed March 24, 1894. In a thermostat the combination with a suitable base provided with opposite contact points, or a lever fulcrumed to said base, an expansion strip attached at one end to said lever at a distance from its fulcrum, and having a contact-piece at its free end between said points and close to the fulcrum of said lever, and means of turning said lever, engaging it at greater distances from its fulcrum than the contacts.

557,282. ELECTRIC CAR HEATER; J. G. Noyes, Milford, Conn. App. filed Aug. 16, 1895. An electric heater having a corrugated heater-body containing electrical conductors embedded in cement in the corrugations on one face thereof, and being provided with perforations between the corrugations which contain the electrical conductors.

557,284. TELEPHONE SWITCH AND SUPPORT; E. C. Paramore, Philadelphia, Pa. App. filed April 24, 1895. In a combined receiver support and cut-out for telephone instruments, and in combination with the contact points of the bell and battery circuits of the instrument, a stationary support, which is bifurcated to receive the said instrument, a movable support eccentrically pivoted to said stationary support, adapted to be thrown in one direction by the insertion of the receiver, and in the other direction by its withdrawal, a rearwardly-projecting arm carried by said movable support, contacts carried by said arm adapted to close and open the battery-circuits of the instrument when the receiver is placed in said supports, and to open the bell-circuit and close the battery-circuit when the receiver is withdrawn from them.

557,320. CABLE RAILWAY; W. M. Wood and J. C. Miller, Elmira, N. Y. App. filed Aug. 26, 1895. In a cable railway, the combination with a conduit and a car, of circuit closers in the conduit, a shaft carried by the car, and having an arm to engage said circuit-closers, a vertically-movable rod on the car, means for obtaining said rod normally elevated, connections between said rod and shaft, and means for releasing said rod.

557,355. GALVANIC BATTERY; E. S. Boynton, Brooklyn, N. Y. App. filed Feb. 21, 1895. A galvanic battery comprising two or more elements grouped in one receptacle and having an electrolyte common to all, each element consisting of pairs of electrodes arranged one within the other, the outer electrode of each pair being held and supported in immediate juxtaposition with adjacent corresponding electrodes by means of a strengthening insulating-medium or bond that extends downwardly to the full length of said electrodes.

557,356. GALVANIC BATTERY; E. S. Boynton, Brooklyn, N. Y. App. filed Sept. 13, 1895. In a battery having an outer containing-receptacle, a series of elements containing each a positive and negative electrode arranged in groups in operative relation to a common elecrotolyte in said receptacle, the outer containing-jars of each element being provided with a series of vertically-arranged holes or passages to afford eduction and induction ports at different levels for a circulation of the common electrolyte.

557,375. CIGAR LIGHTER; J. Frye, Philadelphia, Pa. App. filed July 16, 1895. In a cigar lighter, the combination with a lamp comprising an oil-receptacle and a burner, a terminal or electrode mounted upon said oil-receptacle, an extinguisher comprising a lever pivoted to the top of the oil-receptacle, and having at one end a cap adapted to cover the top of said burner, an electrode or terminal formed upon the outer rim of said cap and adapted to engage the terminal mounted upon said oil-receptacle, a leaf-spring mounted upon the oil receptacle and normally tending to keep said cap in contact with said burner, a handle for operating said cap against the action of said spring, a battery forming a support for said oil-receptacle and having wires leading therefrom, one of which is connected to the fulcrum-point of said lever, an induction coil having a terminal connected to the other wire of the battery, and a terminal connected to the terminal or electrode mounted upon the oil-receptacle and a box-casing for inclosing said parts.

557,384. FAN MOTOR; R. H. Hassler, Dayton, O. App. filed Nov. 27, 1895. An electric motor with field and armature revolving in opposite directions in a vertical plane, a wheel attached to the armature, and a second wheel attached to the field, the two wheels adapted to drive by friction a third wheel revolving in a horizontal plane and attached to a ventilating-fan.

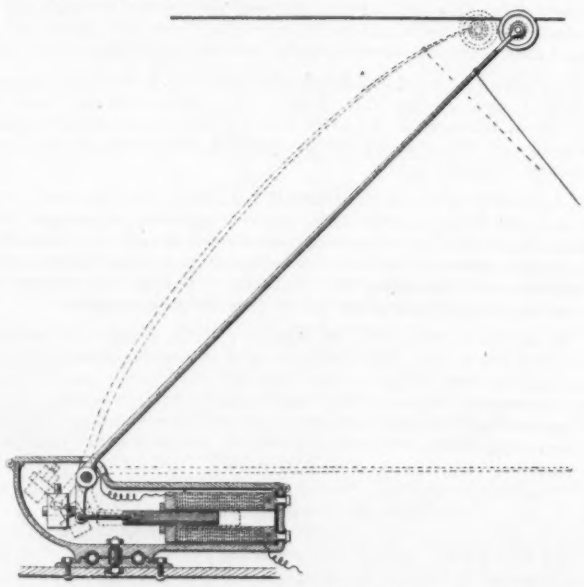
557,386. RHEOSTAT; H. E. Heath, Windsor, Conn. App. filed Dec. 26, 1895. The combination in a rheostat of parallel and non-conducting wire-holders and wires interwoven alternately above and below such holders, for sustaining such wire electric conductor, and by which conductor the wire holders are held in position.

557,398. DISTRIBUTION OF ELECTRIC CURRENTS; I. Kitsee, Philadelphia, Pa. App. filed Sept. 16, 1895. The method of distributing electrical energy, which consists in providing the translating of consuming circuit of a converting device with resistances placed in a shunt-circuit to a resistance opposing the flow of the current in the primary of said converting device, and automatically short-circuiting or cutting out the same through the active of the consuming devices placed in said circuit.

557,422. MEANS FOR TRANSMITTING ELECTRICAL ENERGY; T. W. Onderdonk, New York, N. Y. App. filed April 9, 1895. The combination with an electric circuit having an intermittent device therein of a dental tool-holder comprising an electromagnet in said electric circuit, a tool holder mounted to reciprocate on the electromagnet, an armature having pivotal connections with the electromagnet and serving as a hammer to drive the tool-holder in one direction, and a spring for returning the armature.

557,434. ELECTRICAL LIGHTING APPARATUS; R. A. Schoenberg, J. W. Flucker, and A. N. Keedwell, New York, N. Y. App. filed Dec. 5, 1895. In combination in a Welsbach light having a fragile material, the burner having an indent, and below which a mantle depends, a fixed electrode extending up alongside the burner opposite the indent and within the mantle, and having an inwardly bent upper end, and a movable electrode interposed between the fixed electrode and the indent and means for operating the movable electrode.

557,442. TROLLEY FOR ELECTRIC RAILWAYS; H. A. Seymour, Washington, D. C. App. filed Feb. 1, 1896. The combination with a trolley pole and means for raising the trolley pole into contact with an overhead conductor, of an electromagnet adapted to exert sufficient pressure on the trolley pole to maintain the trolley in good contact with the conductor when the car is running. (See Illustration.)



No. 557,442.—Trolley for Electric Railways.

557,518. CARBON HOLDER FOR ARC LAMPS; C. A. Pfluger, Chicago, Ill. App. filed Aug. 7, 1895. In a carbon holder, the combination of two pivoted clamping jaws with thumb screws, one adapted to control each jaw and both to be moved simultaneously when desired.

557,527. SWITCHBOARD SIGNAL; I. H. Farnham, Wellesley, Mass. App. filed Jan. 16, 1896. An electric signal consisting of a suitable support in which is enclosed an electromagnet, having an iron sheath, and an armature hung by its upper end at the entrance of a cavity in the said support, and in front of the electromagnet.